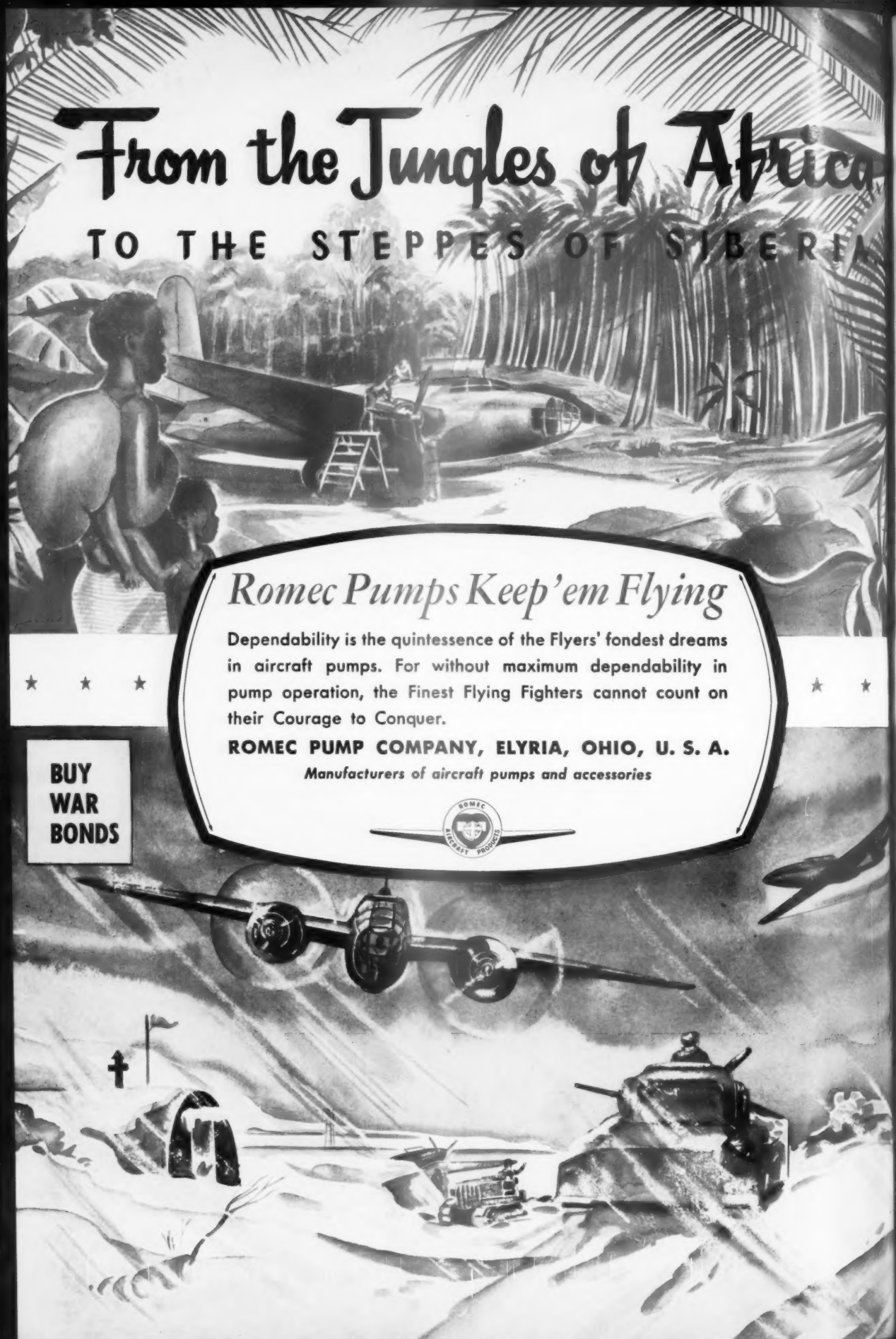
AERONAUTICAL ENGINEERING REVIEW

INSTITUTE OF THE AERONAUTICAL SCIENCES

MARCH 1943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MARCH, 1943

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Trail Blazing in the Skies

1924

THE FIRST U.S. NAVY AIRPLANE to be built with duralumin structural members was the Martin MS-1, produced in 1924. These members were formed by Goodyear for the Glenn L. Martin Company. This important work was entrusted to Goodyear because of our previous experience in building duralumin keels for military airships — the first use of this metal-alloy by any private aircraft manufacturer in the United States.

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Institute of the Aeronautical Sciences Honors Night Dinner

THE ANNUAL HONORS NIGHT DINNER of the Institute of the Aeronautical Sciences was held on January 26, 1943, in the Grand Ballroom of the Hotel Waldorf-Astoria in New York City.

The attendance of 850 was larger than at previous Dinners even though the Technical Sessions on January 27 and 28 were held in Detroit and Los Angeles as well as in New York.

The retiring President of the Institute, Hall L. Hibbard, Vice-President and Chief Engineer, Lockheed Aircraft Corporation, acted as Toastmaster. The program opened with the National Anthem. Excerpts from the speeches of presentation and acceptance of awards follow.

Greeting by the President of the Institute

PRESIDENT HIBBARD: Members of the Institute of the Aeronautical Sciences and guests: Greetings to you all at this 1943 Honors Night Dinner. As you know, our Government has stated that at ten o'clock tonight there will be broadcast an announcement over the radio of the highest priority. We know that you all want to hear this, and we have made arrangements to have this broadcast received in this room at ten o'clock tonight.

These Honors Night Dinners have been organized and managed by the Secretary of the Institute, Mr. C. E. Sinclair, who has for nine years rendered invaluable service. He leaves this week to enter the Army Air Forces, and I should like to read a Resolution passed by the Council at its last meeting.

"*Resolved*, That the Officers and Council of the Institute hereby express their unanimous appreciation for his able, conscientious and unselfish efforts to increase the efficiency and scope of its work and give our best wishes for his success in the war effort."

Speaking of the war effort, we have an Honorary Member who has missed

Hall L. Hibbard.

but one Honors Night Dinner. It is General Arnold. He wished to be with us this year, but urgent duties prevented. His telegram, which he sent us, ends with the following: "My congratulations on the splendid work done by the Institute during the past year and best wishes for continued success."

Tonight marks the beginning of the Institute's eleventh year. It marks the end of its first ten years. Ten years of spectacular growth from an idea in the minds of five men to an institution of over 5,000 members, and with resources that place it among the very top of the world's technical societies.

The Institute is proud of its membership. Included therein are the outstanding aeronautical design and production engineers of America, men to whom this nation looked on that December 7, men who in a little over a year's time gave this nation the best and biggest air force in the world. In its ten years the Institute has helped mold these men and make them better able to do the wartime tasks they are accomplishing so well today. As a member of the Institute, I am sure I voice the opinion of all members by saying we are proud of that record.

Each year the Institute has been fortunate in receiving great gifts, and at these Dinners we publicly show our appreciation. As usual we start our Honors Night Program by hearing the good news from Major Gardner.

Announcement of Gifts to the Institute

MAJOR GARDNER: The Institute has had a most remarkable year. Ten years ago we thought it would be many years before the Institute could take a position alongside the older societies. Now, we are amazed at our present position.

Let me give it to you in just one figure, $1,187,000. That can be considered the net worth of the Institute after ten years. And this does not include the value of our libraries, collections of prints, medallions, music, models and curios. As we cannot even guess at their great value, we carry them at $1.00 on our books.

Gifts have a way of overlapping. For instance, Sherman Fairchild increased his gift for a publication fund to $25,000 this year. He also made a gift that we are announcing for the first time tonight. We needed some furniture, rugs, tables and tapestries, and he presented them to the Institute. They are appraised for insurance purposes at between $25,000 and $30,000.

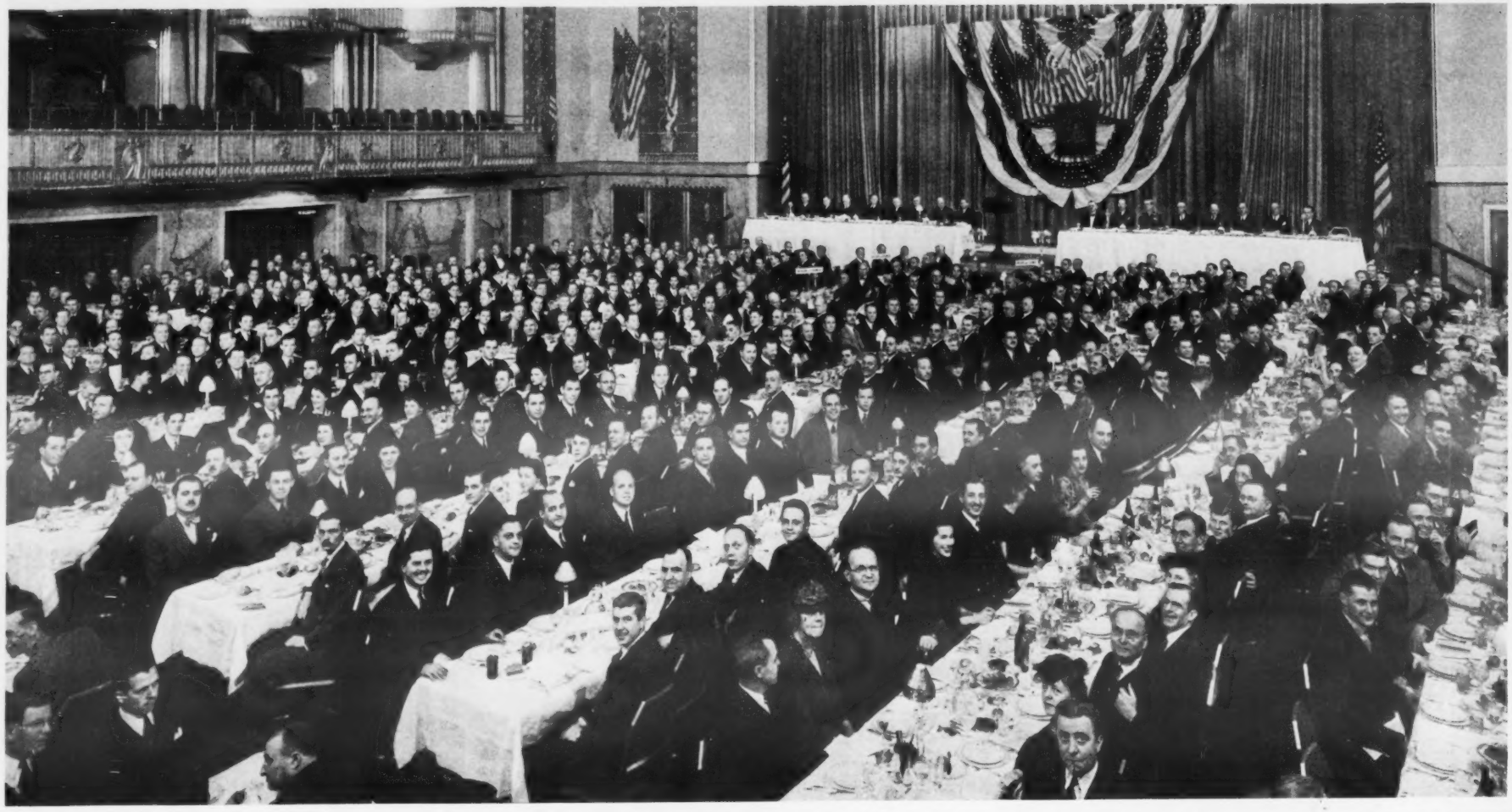
To our continuous benefactor, Sherman Fairchild, I express the thanks of the Institute.

Another overlapping gift is one from that astonishing lady, Mrs. Bella C. Landauer. At our last two Dinners we have acknowledged her gifts of a world-famous collection of aeronautical prints, book plates, music and trade cards of inestimable value.

Mrs. Landauer did not limit herself to the purchase of prints and music. She bought rare aeronautical medals, medallions, dime novels, the rarest books, and even fabrics. She was so pleased to see that her earlier gifts were being used by many for study that she offered the other part of her great collection. It was accepted and as the result the Institute has the finest collection of early Americana in existence.

May I, for you, thank Mrs. Landauer, who is here, for her further generosity.

Another friend has given us his aeronautical library and his great technical files. During his long and distinguished career he had accumulated some of the rarest technical books on aviation and his classified file was just what you would expect E. P.



Honors Night Dinner, Institute of the Aeronautical Sciences, Hotel Waldorf-Astoria, New York, January 26, 1943. The photograph shows approximately two-thirds of the people in attendance at the Dinner.

At the speakers' table (*left to right*) are: A. Lewis MacClain, Head, Installation Flight Test Group, Pratt & Whitney Aircraft Division, United Aircraft Corporation; Charles H. Colvin, Director, Daniel Guggenheim School of Aeronautics, New York University; F. W. Reichelderfer, Chief, U.S. Weather Bureau; Capt. E. O. McDonnell, U.S. Navy; Lester D. Gardner, Executive Vice-President of the Institute; T. P. Wright, Director, Aircraft Resources Control Office, War Production Board; Air Vice Marshal F. W. MacNeece-Foster, British Air Force Delegation; Hall L. Hibbard, Past-President of the Institute; Dr. Hugh L. Dryden, President of the Institute; W. A. M. Burden, Special Aviation Assistant to the Secretary of Commerce; Brig. Gen. David N. W. Grant, The Air Surgeon, Army Air Forces; Dr. Edward C. Schneider, Professor of Biology, Wesleyan University; Dr. J. C. Hunsaker, Chairman, National Advisory Committee for Aeronautics; Igor I. Sikorsky, Engineering Manager, Sikorsky Aircraft Division, United Aircraft Corporation; Frank H. Russell, President, Manufacturers Aircraft Association; Edward C. Wells, Assistant Chief Engineer, Boeing Aircraft Company.

Warner to compile. For enlarging our rapidly growing Archives I thank you, Mr. Warner. Incidentally, it was he who gave the Institute its name.

Our friend, Major Fleet, gave us $10,000 but didn't tell us what it was to be used for. Recently he was here and decided that he would like to have the yearly income devoted to an award in memory of our old friend Col. Thurman H. Bane. It is to be given for technical achievements in the engineering branch of the Air Forces.

And now we wish to express our appreciation for two of the greatest gifts ever made to a scientific society. You have all read about the great generosity of Mrs. Daniel Guggenheim in giving, in memory of her husband, the large estate at Sands Point to the Institute. Recently, a book was published, which many of you have seen, which gave the history of the Daniel Guggenheim Fund for the Promotion of Aeronautics. It has taken ten years for the foresight of this greatest benefactor of aviation to be translated into accomplished facts. It is a record that will always be interwoven with the progress of aeronautics. Quite fittingly the book closes with the recent gift to the Institute and shows the beautiful mansion located in a great park. We are sorry that Mrs. Guggenheim is not able to be with us tonight and receive our personal appreciation.

I would not wish to leave with you the impression that the idea of the gift originated with Mrs. Guggenheim. It was her son, Harry, who made the first suggestion and carried forward the plans for the gift. He even went further than that. Knowing that the Institute would be under heavy initial expense, he secured a gift from the Daniel and Florence Guggenheim Fund of $5,700 which helped defray some of the expense of operation. Harry is on active duty with the Navy, and we are sorry that his duties prevented him from being with us tonight.

Even the remarkable gift of this estate did not close the Institute's good fortune for the year. The Institute could not afford to transform the buildings on the estate into libraries, laboratories, and other uses, so I discussed the problem with the first donor to the Institute, its past-president and constant supporter, Glenn L. Martin. In a short 30 minutes he agreed to a plan that will, within the next three years, give the Institute an endowment of nearly a half million dollars, the income from which may be used to maintain this great estate as well as for other Institute uses.

As you know, he gave this fund as a tribute to his mother. I have known Mrs. Martin for 25 years, and I believe that if the great Martin Company had been named Minta Martin and Son it would have indicated the important part she has played in its development.

To the third lady whose name will always be inscribed on the Roll of Honor of the Institute I send our gratitude and greetings. Mr. Martin, will you please give her our best wishes and say that we are sorry that she could not be with us.

I have put the emphasis of this gift on Mr. Martin's mother as I know he would wish me to. But, after all, it was because of his creative genius and his wish to recognize the assistance that the engineering profession has been to him that he made this superlative contribution. I know that I am voicing what is in the mind of every member and friend of the Institute when I say: "Mr. Martin, you are a farseeing friend of the Institute, and we are grateful for your effective generosity."

As I have said before at these meetings, my address is Rockefeller Center in case anyone present wishes to discuss putting any of his money to work for our astonishing Institute.

PRESIDENT HIBBARD: Sir Richard Fairey, who was to be our guest speaker, telephoned this morning and said that most important developments would prevent his being with us tonight. We asked him if he would invite one of the R.A.F. officers who are now in the United States to come and tell us something of the war in the air. In a few minutes he told us that Air Vice Marshal F. W. MacNeece-Foster, Deputy Head of the Royal Air Force Delegation, had accepted our invitation. This Air Vice Marshal has had a distinguished career. After attending Sandhurst, he entered the Army in 1909. He transferred to the Royal Flying Corps in 1914. He flew in France and was wounded in 1918 Later, he served in the Middle East and was on the staff of the Air Defense of Great Britain in 1925. I might add that due to the shortness of time he has not been able to prepare a set speech.

We are honored to have such a distinguished brother-in-arms with us tonight.

Air Vice Marshal MacNeece-Foster

AIR VICE MARSHAL MACNEECE-FOSTER: Mr. President, and Gentlemen: I suppose this is one of the most nervous moments in my life. It was through no disrespect to you that I was unable to prepare a set speech, and in any case I should have found it difficult to speak here tonight. I do not suppose that any British officer who has the privilege to wear the uniform of the Royal Air Force could speak at the Honors Dinner of this great Institute without a feeling of profound gratitude, even of emotion, and I shall tell you why.

I have been in England during the bad times of this war, and one of the very few bright streaks in a cloudy and somber sky was when we heard that your great country was going to give us air support, and it brought a note of relief to a country that was beleaguered and battered but still remained utterly indomitable.

The memory of listening to those broadcasts quite clearly comes back to me; how splendidly you have kept that undertaking, that high purpose of your country, is now history.

It is now ten years since your Institute started, but I understand that in more ways than one this is perhaps the most memorable dinner you have had, because for the first time you can see in every corner of the world the fruit of your labors: Guadalcanal, Midway, England, Egypt, North Africa, Russia.

I had only yesterday a letter from a young American flying officer. He told me that when he had been to ancient cities, first in India and then in China, of how his great American aircraft was hailed as a kind of emblem and symbol of freedom. He said: "I like those old cities, but the old city I am looking for next is one in Japan."

Air Vice Marshal MacNeece-Foster.

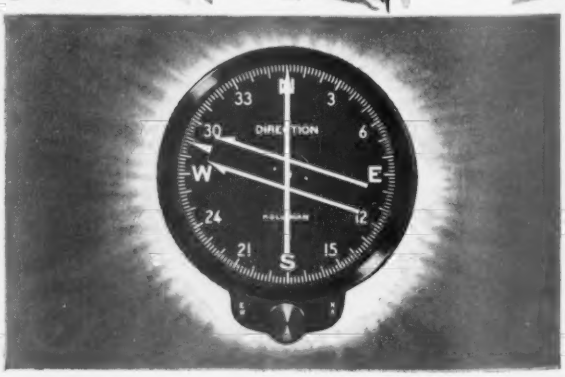
Gentlemen, the sense of contrast with the days that I was thinking of is stronger tonight than ever before because of the good news that has been coming in. I mean news that has almost seemed unbelievable, even for you. I think you will understand what I mean when you remember the trying

President of the Institute; Dr. Hugh L. Dryden, President of the Institute; W. A. M. Burden, Special Aviation Assistant to the Secretary of Commerce; Brig. Gen. David N. W. Grant, The Air Surgeon, Army Air Forces; Dr. Edward C. Schneider, Professor of Biology, Wesleyan University; Dr. J. C. Hunsaker, Chairman, National Advisory Committee for Aeronautics; Igor I. Sikorsky, Engineering Manager, Sikorsky Aircraft Division, United Aircraft Corporation; Frank H. Russell, President, Manufacturers Aircraft Association; Edward C. Wells, Assistant Chief Engineer, Boeing Aircraft Company.

"She takes me there and she *Brings me Back!*"

"MAYBE ORPHAN ANNIE'S not as pretty as she used to be. Jap AA has lifted her face a few times, and her skin's lost that school-girl complexion. But she takes me where I'm heading for, and then she *brings me home.* And the dials on her instrument panel are the sweetest sight a man can see when he's five hours out and getting homesick."

"AFTER THE WAR, my wife will probably have *her* say when we shop for a family plane. She can have her choice of color, but I'll choose the instruments—*precision* instruments that can take it when the going gets tough, and still tell the *truth.* When I fly, I want to know where I'm going. With me, it's not *how fast* . . . it's *how sure!*"



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days of five or six months ago when the issue seemed to hang in the balance at Guadalcanal, and the tremendous magnificent successes that have occurred since; and when an Englishman thinks of the heavy burden, the heavy inferiority during the first three years of the war, the present change seems to be nothing less than to another world.

But tonight, as your President has said, there is quite another reason. I have had for some time the honor to sit on the combined Chiefs of Staff Committee at Washington, and I shall not anticipate that glorious message that is coming through at ten o'clock tonight, but I feel sure of one thing: that it will reveal a story of intrepidity and gallantry not only of young people but older men, and that it will bring a tremendous addition to morale in our two countries, and above all, that it will spread a feeling of disillusion and impending defeat on our enemies.

Sir Richard Fairey, who has expressed his great regret at not being here, would have mentioned himself and would, I know, have wanted me to mention the great sense of indebtedness which the Royal Air Force in England feels in particular to one member of this great Institute. I think it is hardly necessary for me to say that throughout England, particularly on his recent visit, Mr. T. P. Wright has won for himself the greatest esteem and the greatest gratitude.

It was suggested to me that because I was not competent to speak on aeronautical matters in a highly technical institution I might say one or two things about several of the problems which, I understand, are exercising a good number of people in the United States, and there were three questions that it was suggested I might try to deal with in a very simple way. The first is some few general observations about the bombing of Berlin and the bombing of Germany. The second is a question that I have often heard discussed—why the great thousand-aircraft raid on Cologne hasn't been more often repeated; and third, a very highly contentious question—whether bombing can finish the war.

The recent bombings of Berlin were not a chance matter. They were part of a coordinated scheme. We knew of the proposed Russian advance. We knew of the Tunisian success where the pincers were already forming on Tripoli and the two great armies of General Eisenhower and General Montgomery were fast advancing, and we felt that by the dropping of many hundreds of tons of bombs on Berlin there might be an outward, visible sign of what was happening which all the propaganda of Dr. Goebbels could not conceal.

But to turn to one or two other places, Lubeck and Rostock, two ports that acted as great centers for material and which were used as bases against Russia. In the spring of last year we heard that an offensive was going to be launched against the northern front, against Leningrad, and as a result of it Rostock and Lubeck were repeatedly bombed. The material damage was so great that the proposed bombing offensive against Leningrad, whose relief we gladly recorded yesterday, never materialized. That is one of the examples of the strategic consequences of bombing.

Let me give you another. The R.A.F. completely wiped out Germany's biggest mine plant in Duesseldorf. In Rostock the big Heinkel plant was almost entirely destroyed. The aircraft it might have made will never fight General Eisenhower's pilots or attack American convoys.

In Cologne 250 factories were completely obliterated. The weapons they might have made will never be used in Russia. That is just a hasty picture of the military results of this bombing offensive.

Again, I should like to say something on a point that has been raised several times, and that is why the Cologne raids have not been repeated. I think the answer is a very simple one. The Cologne raid in June was something in the nature of a special affair. We used every bomber we had. We used aircraft that were normally employed in operational training. The reason that we have not been able to repeat the raids on Cologne is simply this: We have not enough aircraft. But I do not want to speak on a pessimistic note. Never, despite three years of war, has the production in England of aircraft been so high as it is at present. We estimate that England will be turning out 25 per cent more aircraft in 1943 than it did in 1942, and many of them are some of the finest four-engined bombers in the world. We are grateful for the splendid re-enforcements that will come from the United States of America.

It has been my privilege to meet when I was in England a great many young officers from the United States, and one of the things which I think is most encouraging is the feeling of cordiality and good will and mutual self-respect that exists between the Bomber Command in England and the United States Bomber Forces in England. They look forward, as nothing else, to the day when they will join in new raids on Germany which will make the raid on Cologne sink into insignificance.

There is just one other question that it was suggested I might try to answer: Can bombing in itself win the War? Bombing in itself may not win the war, but the war will not be won without bombing Germany. There is no royal road to victory. The other factors are this great Russian advance, a second front, a remorseless blockade.

Of one thing I am sure, that a continuing and increasing offensive will dislocate war material and production in Germany to such a degree that the German armies will eventually be unable effectively to fight. I believe that day will come sooner than we think, once we can step up our bombing offensive.

But there is one lesson that I think we all ought to learn here and that is that the great aim for all of us should be not only to build vast quantities of aircraft in this great country and in my own but to work out a system by which in the minimum of time they will have the maximum impact on the enemy.

I know that that view is one held in the highest quarters in your country. It is held in mine, and I have high hopes coming events will in some way go to implement it.

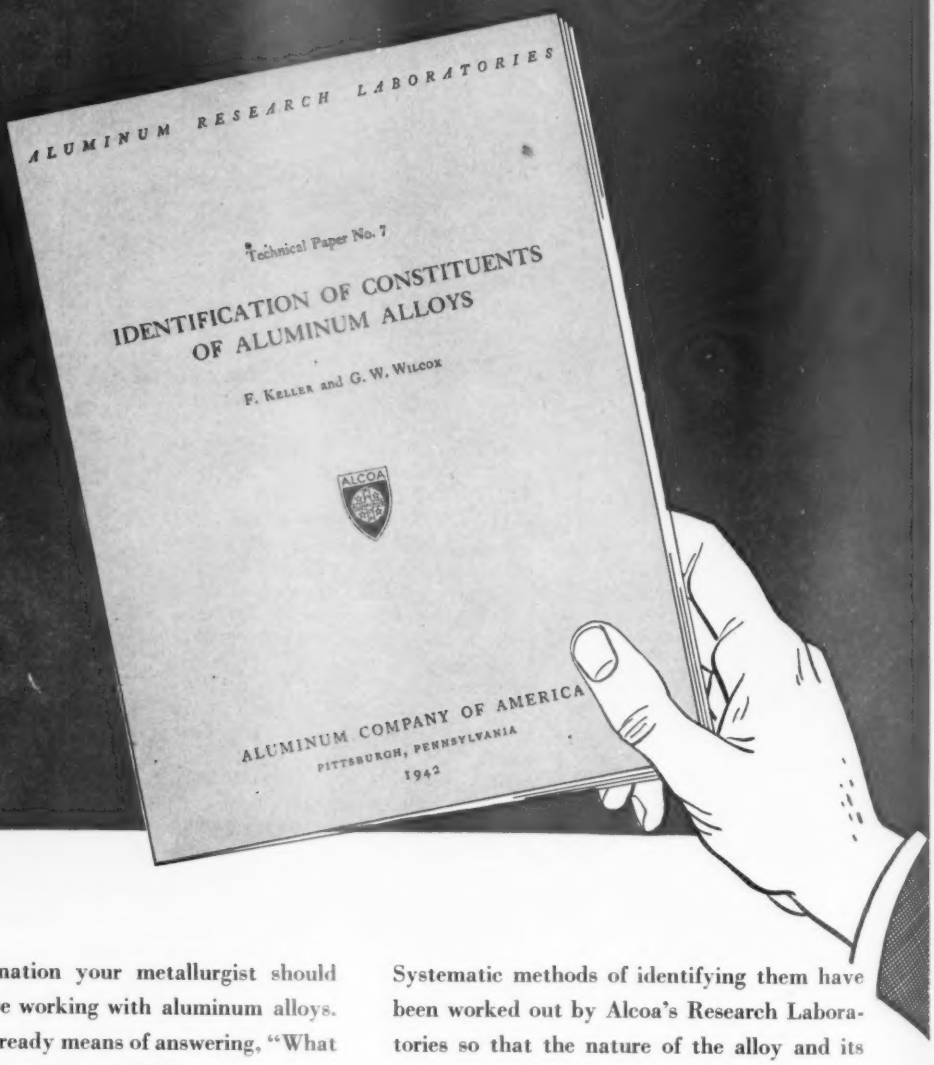
I am very grateful to you for the honor you have done me, but far more important than any personal gratitude, I stand tonight in some humble manner to express the gratitude of the Royal Air Force and of the people of England to this great Institute.

I am quite sure that when the history of this war comes to be written, the verdict will be that one of the greatest bulwarks against barbarism, one of the surest aids for the preservation of everything that we think is decent in life, will be found in the ingenuity, the determination and the scope of the great work for aviation for which you all here are so responsible.

May you prosper! May you continue to excel! And perhaps a grateful guest in your midst may venture the hope and the belief that in the future your achievements will be even greater than those splendid ones that you have already accomplished.

PRESIDENT HIBBARD: When the history of this war is written and the story of the colossal problems of aircraft procurement can be told, no one will receive greater credit for organizing this great program than our past-president, Ted Wright. Recently, he received a great honor. The Royal Aeronautical Society in all its 75 years has elected only 15 Honorary Fellows. Of these, four have been Americans. Orville Wright was the first, and the three others are on our program tonight, Dr. Hunsaker, Major Gardner, and now we are to hear from the fourth.

To help your metallurgist tell "*Whats in it?*"



Here's information your metallurgist should have, if you're working with aluminum alloys. It provides a ready means of answering, "What type of aluminum alloy is it?"

Technical Paper No. 7 presents metallographic methods for examining aluminum alloys. How to prepare a specimen is told in detail; cutting the sample, mounting, polishing and etching.

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Your metallurgist may want a copy of Technical Paper No. 7. Write ALUMINUM COMPANY OF AMERICA, 1980 Gulf Bldg., Pittsburgh, Pa.

ALCOA ALUMINUM

Mr. T. P. Wright

MR. T. P. WRIGHT: I was given no set topic on which to speak tonight but was asked to choose my own. I have elected to speak on three subjects briefly. First, a trip to England; second, Washington; and third, The United Nations.

I am going to depart from usual practice and introduce each of these subjects with a stanza from a poem. I was honored to be selected to head a mission to England about four months ago. We were greatly impressed by what we saw and of how it evidenced what England had withstood. I was constantly reminded of this poem:

"For all your days prepare
And meet each ever alike
When you are the anvil, bear;
When you are the hammer, strike."

England has played its "anvil" part. That was very much in evidence as you walked around London and saw in every block at least one or two vacant places where buildings had previously been. If you walked in certain sections you would see square block after square block that was missing, and even some, perhaps, a mile square. It was very easy to see what it was that the English had had to take. It is therefore, considering what was at stake, proper, I am sure, to say in answer to the very kind remarks of Air Vice Marshal MacNeece-Foster, that we will everlastingly be in the debt of England; no matter how much we may now do, the debt of ourselves and of civilization itself can never be repaid.

American Mission to England

The reception our mission received in England was exemplary. The English do these things, I think, better than anyone else in the world. We were treated royally. Everything was planned magnificently.

Let me give some of our impressions: First, there was the general feeling of determination of the English people which we all felt from the outset. This was shown perhaps more than anywhere else in the factories, where the intensity of labor effort was obvious. We were greatly impressed by the job that the women of England are doing, whether in uniform or in the factories. Their factory force now totals something over 40 per cent women workers. We were impressed by the way they have been able to carry on their production effort in the dispersed factories, made necessary by the intensive bombings they had suffered and must still be prepared against.

T. P. Wright.

In some places there would be two or three assembly plants, with perhaps 40 or 50 small factories, garages, stores, and the like, within a radius of 50 miles, building components for the assembly. For instance, in Southampton, a magnificent plant that I had seen four or five years before, was completely bombed out but, without serious loss of production, had been able to disperse into 50 factories and to carry on at a very fine rate of production, contributing substantially toward the saving of England in the Battle of Britain.

In production, we noted that they were able to carry on with tools which, in general, were older than ours. Production methods, because of the dispersal of plants, do not approximate line production as we are able to accomplish in this country in our undispersed factories. In matters of material control, I think they have surpassed us. I heard very little of shortages of material in the many plants that we visited.

The quality of their product is good, both in workmanship and design, as demonstrated by effectiveness at the fighting front. They have carried out the continuing development of types that were started early very well indeed. I cite cases such as the Rolls-Royce Merlin engine, The Spitfire, the development of complete power-plant installations, the development of automatic controls, and there are many others.

Of course, we were all thrilled at the opportunity of visiting some of the fighter and bomber commands. We spent a day at the Fighter Command of the Royal Air Force under Air Marshal Douglas, who very kindly explained the method by which they operate, the way in which they protect Britain and can detect any incoming enemy forces, and how they send out their fighters to meet them.

We were also thrilled when we went to American Headquarters where we saw General Spaatz and were shown photographs that they had taken before and after bombing by our own aircraft. I recall particularly a sequence of a raid on the submarine base at Lorient.

I think it is certainly true that in this great effort in which our several countries are involved, we can be complementary to each other in our efforts. This can apply alike in engineering, wherein we exchange designs and thereby save time by eliminating duplicated effort; it can be demonstrated in production methods whereby we can exchange ideas and increase the output of each of us; and it can be shown in tactical and operational uses of aircraft, a notable example being the fact that we are able now to strike our enemy day and night, using our day bombers and their night bombers.

There is a return mission of the British in this country at the present time. They are on the West Coast investigating our production methods and determining, by inspection, ways to increase their production. It is very difficult in England at this time to increase man power on the job very much. They have therefore to increase their output by increasing efficiency.

The value of missions of this kind is not only in the interchange of ideas but, more than anything, in the spirit of cooperation they engender and which, I am sure, will carry on after the war is over.

These points were discussed when I was so highly honored by having the privilege of an audience with His Majesty The King. We discussed for three-quarters of an hour the matter of exchanges of missions, of getting the two people together more closely, and of helping each other in places where the one or the other of us might be deficient.

His Majesty is very well up on aviation. He knew all of our types, and the British types well, from a technical standpoint. He was also acquainted with all of the English factories, which he had inspected at numerous times in the last two or three years.

So let us not get the idea that in this joint effort we are competing in any way—there is plenty of war to go around!

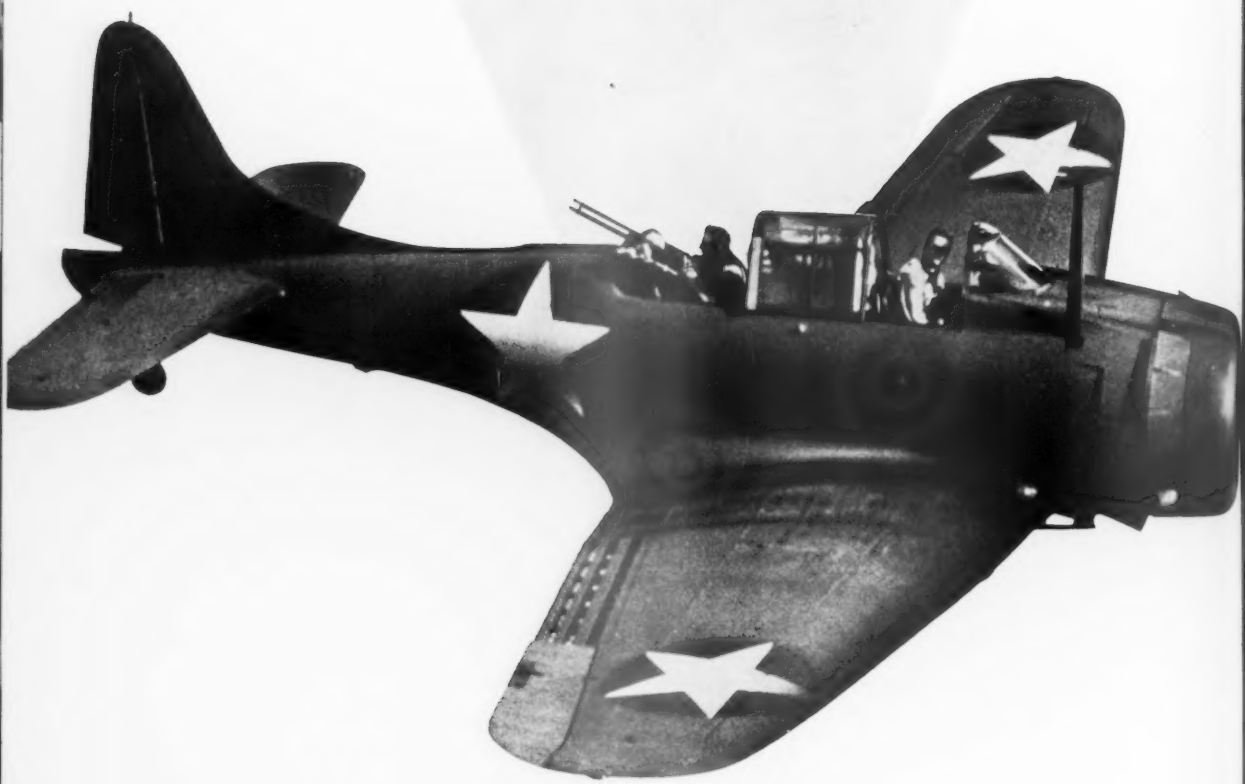
Aircraft Planning in Washington

Now as to Washington, I will start with a poem from that old Persian poet, Omar Khayyam. It goes as follows:

DOUGLAS

Dauntless

THE WORLD'S HARDEST HITTING DIVE BOMBER IN U.S. NAVY SERVICE



Douglas

(1) C-54 "Skymaster" (2) C-47 "Skytrain," C-53 "Skytrooper" (3) A-20 "Boston" A-20 "Havoc" (4) SBD "Dauntless," TBD "Devastator," A-24 "Banshee"

DOUGLAS AIRCRAFT COMPANY, INC.
SANTA MONICA, CALIFORNIA
MEMBER, AIRCRAFT WAR PRODUCTION COUNCIL, INC.

"And that inverted bowl we call the sky
Where under crawling, cooped we live and die,
Lift not your hand to it for help
For it rolls impotently on as you or I."

Above all, to win this production effort we need an aggressive industry, a resourceful and a self-confident industry. There is nothing that Washington or any agency can do to supplant these qualities in private industry. And yet there are some things in an all-out effort which a central agency such as we collectively call Washington must do. This, of course, has to do with the distribution of materials, tools and, later, man power into the various service efforts which they must implement.

The particular branch to which I have been assigned is the Executive Agency of the Aircraft Production Board known as the Aircraft Resources Control Office. It has as its object the balanced distribution of those things that I have just mentioned representing the "tools" with which the industry must work. Production, after all, is simply the conversion of materials into a finished product by means of management directing labor that uses machine tools for the job.

There have been several phases in our effort in Washington. The first one was to try to get some semblance of a program on which we could work. Then came the facilities phase, when we had to get new facilities erected in order to supplement the existing aircraft industry. This brought in production of machine tools, which in the years 1940 and 1941 was the big problem. Then we came into the material trouble, which went through 1941 and is still with us. But the final, limiting factor in our program will, of course, be man power. We are finding that more and more to be the case, and therefore we are going to direct more and more attention to that part of the problem.

The members of the Aircraft Production Board made a trip recently to the West Coast where we saw many things, some of which we were glad to see, and some of which we were sorry to see, and others of which we were sorry to hear. In general, facilities are now quite well completed. There are three or four large aircraft factories still building, but insofar as building and distribution of tools are concerned, we are in quite good shape.

So far as materials are concerned, we are in a position more of unbalance than lack of materials, although in many instances we are in serious straits. It is true there are some fabricated forms of materials that are deficient and these we are going to try to build up as rapidly as we can, but the big thing is the distribution of materials and elimination of present unbalance.

For example, there are now inventories in the industry, taken in tons, which are satisfactory. However, taken in terms of individual parts and shapes, etc., they are unsatisfactory. Obviously, the output of airplanes will depend on the weakest link in the chain. Therefore, it behooves us to assume the responsibility of eliminating this unbalance in materials.

But the most disturbing thing to me on this trip was the problem of man power. Certain phases of which were quite discouraging—for instance, absenteeism, which has been much in the news recently. We found cases where there was as high as 10 per cent, on the average, of the workers absent each day from their jobs. As General Knudsen so rightly put it: "There is no absenteeism in the Solomons."

I think this is a problem that we must all attack by every means we can because the unproduced airplanes represented by the potential production effort of those people who are willfully absenting themselves from their work represents somewhere on the order of 500 airplanes a month. We simply cannot afford that much of a loss at this time; we must and will solve the problem.

We are securing women workers in the factories at a satisfactory rate. The percentage is now something over 25 per cent and will be 40 per cent by this summer, which, incidentally, is about the same as now maintains in England and is probably about as far as we will be able to go.

The matter of labor turnover is distressing. It is far too high, and means must be found to whip this problem also. There are problems still before us having to do with simplifying our programs, but I think we need not anticipate too much help in this regard, because it must be remembered that in order to simplify a program it means taking something out of production now and losing for the immediate future a certain number of planes. We feel that the output in 1943 is so all-important that it is likely we cannot take many types out of production, even though in the long run it would perhaps be a good thing for production output.

We were very favorably impressed by the way the aircraft industry has gone into line production. I think they have struck a very happy balance between the super, mass production methods of the automotive industry and the previous piece-work, hand-building type of job which small orders necessitated in the aircraft industry. They are doing an excellent job. For example, the moving conveyer lines that you see in many factories are gratifying and indicate that we are on the right road as far as increasing our production is concerned.

It is also very gratifying to note that the rate of improvement of efficiency in our factories is progressing about along the line that had been hoped for but which many had doubted could exist. The companies as a whole are able to increase their efficiency in terms of man-hours per pound about on an 80 per cent curve, which means each time the quantity per month is doubled they only expend 80 per cent of labor compared to what they did under the original quantity.

There are many other troubles, and the aircraft industry comes in for a lot of "ribbing" on not getting under way, but let's look at some of the facts and see what has been done. In 1940 we turned out a little over 6,000 planes. In 1941 this arose to 19,300 planes and in 1942, just under 48,000 planes. Or, again, put in terms of a shorter period; in December, 1941, we turned out 2,400 planes; in June, 3,700; and, as you recall the President saying, in December, 5,500.

Now, those are astounding rates of increase, where in December, 1942, we turned out almost as many planes in one month as we did in the whole year of 1940! And that is not the whole story. The weight of these planes was going up steadily during that period. In terms of increase in pounds of output, the relative ratios for those three years were 1, 4, and 14, and in 1943 this rate of increase will continue.

In terms of comparison of our output with the output of other countries of the world, I think I am safe in saying that by late this summer, if not indeed before that, we will turn out as many planes per month in this country as in all the rest of the world combined!

And quality has kept pace with production. We have continued our research and development. As you know, in combat use against our enemies the ratio of their losses to ours has been from 3 to 1 at the least up to as high as 10 to 1 in many engagements. This is indeed proof of the quality of the planes we are turning out and of the men who fly them!

Of course, this matter of research and development is what makes aviation so interesting. There appears an inscription in front of a Los Angeles store which says: "To build a business that shall never know completion"; that indicates why we never can get away from aviation once we get into it, as we know our job will "never know completion."

The United Nations

Now for my final topic: The United Nations. The change from the de-

Petroleum Research and War in the Air: Number 2 in a series of original Esso research developments that help give U. S. planes an edge in the air.

Not many years ago, "hydraulic" to most people was just the name of a new-fangled auto brake.

No need to tell a flyer today how much more than that it is, with controls from landing gear to gun turrets dependent on hydraulic operation!

When you consider that the same plane may take off in ground temperature well over 100, and climb straight into stratosphere cold way below zero—you can see that something *very* special was needed in the way of a hydraulic oil.

Out of our Univis 40 has come the answer. Through processes discovered some five years ago in Esso laboratories has now been developed Univis J43—a hydraulic oil that'll flow, pour, and stay on the job both hotter and colder than you'll ever find a place to fly it!

For the present, of course, military needs take the entire output of Univis J43.

The Univis group is based on one of many special processes first discovered in Esso Laboratories. Esso research is one reason why the U. S. makes more effective use of its petroleum resources, in peace or war, than any other country on earth!

*ARMY-NAVY SPECIFICATION AN-VV-O-366a.

fensive to the offensive at last makes it appropriate to discuss the peace afterward, as well as the winning of the war.

A consideration that I think is of the utmost importance is that with the advent of the airplane, *the world now becomes of manageable size.* A brief digression into history will perhaps bring out my point. In the fifteenth century the feudal system was coming to an end. It had been able to last because of the impregnability of the feudal castle; then the invention of gunpowder made the castle indefensible, which brought about a complete change in the political setup in which many principalities and nation states came into being. Now, that state of affairs carried forward until the present time, implemented in the later centuries by so-called balance of power.

This was a tenable scheme of organization because of the fact that *then* a small state with a fairly good army could withstand a powerful neighbor at least sufficiently long to permit the balancing force of its allies to come to its aid. Now, that can no longer be maintained with the advent of air power. A new order is therefore inevitable.

Air power, by virtue of its mobility, makes it possible adequately to police large territories of land and to prevent aggression on the part of any power so minded from starting. It therefore seems to me that from this United Nations, established in this war, we can expect something fine to develop; something lasting; a peaceful world order, policed from the air.

It was indeed impressive when we went over to England and then back, to fly from such magnificent airdromes, and to appreciate that present plans call for scores of flights a day between England and the United States from these airports next summer. If one tries to visualize that and interpret the results in terms of four-engined transport planes, it is readily seen what we are coming to, in *this air age.* We must all remember that the world being of "a manageable size," we can reasonably hope that once the war is won we can be assured of a better world, dominated commercially and maintained in peace—both from the air.

PRESIDENT HIBBARD: The transformation of civil air transport to war service has been one of the great marvels of military and naval logistics. The man who is now directing the greatly expanded work of the Civil Aeronautics Administration is one of the great friends of the Institute. Several years ago the Institute was a small one-office affair. Mr. Burden changed that when he offered to place in our custody his great aeronautical library, the greatest privately owned collection in the world. From that offer came the idea of our Aeronautical Archives, which has expanded to such an extent that the Institute now has undoubtedly the greatest sources of aeronautical information available anywhere. We appreciate his great contribution to the growth of the Institute.

Mr. W. A. M. Burden

W. A. M. Burden.

MR. BURDEN: The greatest war in history has placed tremendous responsibilities upon our shoulders. It is not too much to say that the safety of our nation is in keeping of our aeronautical engineers to almost as great an extent as it is in the keeping of the armed forces. In the last struggle it was said that Admiral Jellicoe was the only man who could have lost the war in an afternoon. In this war, there are a dozen men who could lose it with a slide rule.

The story of the enormous contributions of the air lines is, of course, a familiar one. It is a great satisfaction that their achievements both in regular operations and in those conducted for the Air Transport Command and the Naval Air Transport Service have been recognized by the award of the Collier Trophy.

There are, however, other important sections of civil aviation, of which we read but little in the daily press, which are playing a fascinating and important role. The remarkable performance of the Civil Air Patrol in antisubmarine work and courier service is just becoming known. We can only applaud the devotion and spirit of sacrifice of many of its members who, though past military age, have risked their necks and their airplanes to plug a gap in our national defense.

I wonder, too, how many of you realize the nature of the task being performed by the employees of the Civil Aeronautics Administration and by that vitally important part of our civil aviation industry, the fixed base operators. There are some 6,000 accomplished technicians working in C.A.A., almost every one of them has a job open for him in private industry or in the Armed Forces—in the latter case, often with commissioned rank.

The secretaries of War, Navy, and Commerce have determined that these men can best help in the war by continuing to work as an organization in civilian status. They have taken that decision at the face value. Without the recognition that is accorded by a uniform, without the pecuniary reward of the high wages private industry can pay, these men are sticking to their jobs.

They are carrying out a tremendous assignment. We have come to take the smooth functioning of our airways system for granted, but I can assure you that it is no easy task to maintain that smooth operation under war conditions. Airways traffic is three times what it was last year, and over 80 per cent of it consists of military airplanes, many of them flown by pilots with comparatively little training measured by the air-line standards of peacetime.

In addition to operating the domestic airway network, C.A.A. is building vital new airways for the Army Air Forces in foreign lands. The load on them is a heavy one, but they are carrying it.

Finally, the C.A.A. War Training Service, formerly the Civilian Pilot Training Program, is coordinating the activities of the private flight operators of the country into a vast training machine, which is a unique contribution of civilian aviation to the war effort, a machine so typically American that it could not exist in any other country but the United States. That machine was created by my farsighted and able predecessor, Mr. Hinckley. It employs some 600 operators, some 5,000 airplanes, and some 8,000 employees, of which 3,400 are flight instructors. It has become thoroughly integrated into the training program of our Navy and, more recently, our Army.

Today, almost every cadet who enters naval flying starts his training in the C.A.A. War Training Service. Navy figures testify to the value of the training these men get in the C.A.A. schools. Statistics compiled last sum-

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AEROLS* serve on trans-hemisphere air route

Transport planes of Pan American Airways' famed Africa-Orient division are equipped with Aerols, including dual-tired main legs. Thanks to Aerols, those huge cargo carriers take off with effortless ease from Florida runways. Laden with vital war materiel, they soar safely above sub-infested ocean, tropical jungle and desert sands. Finally at a remote African base, these planes make soft, cushioned landings on Aerols. Plane, crew and cargo are completely protected.

Thus Aerols contribute to the successful operation of Pan American Airways' strategic supply route. And on every other front in today's global warfare, Aerols aid in the superb "ground performance" of American aircraft.

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AEROLS*

*THE SHOCK ABSORBING UNITS ON AN AIRPLANE'S LANDING GEAR. THE NAME IS DERIVED FROM THE WORDS "AIR" AND "OIL"—THE FLUIDS USED TO DISSIPATE THE LANDING SHOCKS

mer show that only 4 per cent of Navy cadets who have completed the W.T.S. elementary course of 35 hours failed to complete their naval flying training successfully. In the case of men without W.T.S. experience, the ratio of failure was 20 per cent.

The Army has just embarked on a program for a much wider use of W.T.S. training than ever before. Besides continuing training of a considerable number of Army men who will eventually qualify as transport pilots and instructors, W.T.S. is embarking on the giving of new special qualification courses for a very large proportion of Army cadets prior to their entry into Army Air Forces schools.

At the present time a large number of these men are in the Enlisted Reserve, awaiting call to active duty. It is expected that they will be called in the near future and assigned to approximately 100 colleges selected throughout the country in localities where flying fields are conveniently available.

At these colleges the men will receive, starting next April, a course of study and training under the direction of Army Air Forces officers. This course will be supplemented in its latter part by some ten hours of flying instruction in light airplanes given by the C.A.A. War Training Service. Men who are found unqualified for additional flying training will be eliminated as pilots and will be used in other capacities by the Army Air Forces. In this way the percentage of cadets eliminated in the regular Army Air Forces schools should be reduced and the work at these schools benefited.

The enlargement of C.A.A.'s elementary schools at these 100 colleges to the point where they can handle the several thousand men that the Army expects us to train each month will be no easy task. It will require considerable reorganization on the flight contractors' part and the mobilization of the country's resources of light airplanes. However, C.A.A. and its contractors have undertaken tough jobs before and they will complete this one successfully. When the project is completed and the schools are set up and going, I believe that American civil aviation will have made another vital contribution to the war. Moreover, it will be a contribution that will be accomplished with a minimum of strategic materials, a minimum of man power, and a reckless expenditure of sweat and horse sense.

The kind of cooperation between the civilian and military elements of our nation which such an effort involves results in an unbeatable team and one that every American can be proud to play on.

. . . . The audience listened to the radio announcement of the Casablanca Conference. . . . .

The Sylvanus Albert Reed Award

"For a notable contribution to the aeronautical sciences resulting from experimental or theoretical investigations, the beneficial influence of which on the development of practical aeronautics is apparent."

The late Dr. S. A. Reed, designer of metal aircraft propellers and a Founder Member of the Institute, bequeathed an endowment to the Institute in 1933 to provide an annual award with a certificate and honorarium of two hundred and fifty dollars. The recipient of this award is chosen by ballot of the American Honorary Fellows and Fellows of the Institute, who now number over a hundred of this country's leading aeronautical scientists. In 1942 their selection was

Igor I. Sikorsky

"For the creation and reduction to successful practice of a helicopter of superior controllability."

PRESIDENT HIBBARD: The presentation of the Reed Award will be made by the first President of the Institute. It was Dr. Hunsaker and Lester Gardner who were the real founders of the Institute, and to no one are we more indebted for advice and guidance than Dr. Hunsaker. No one could have been selected who could more appropriately present our scientific award to another great aeronautical scientist.

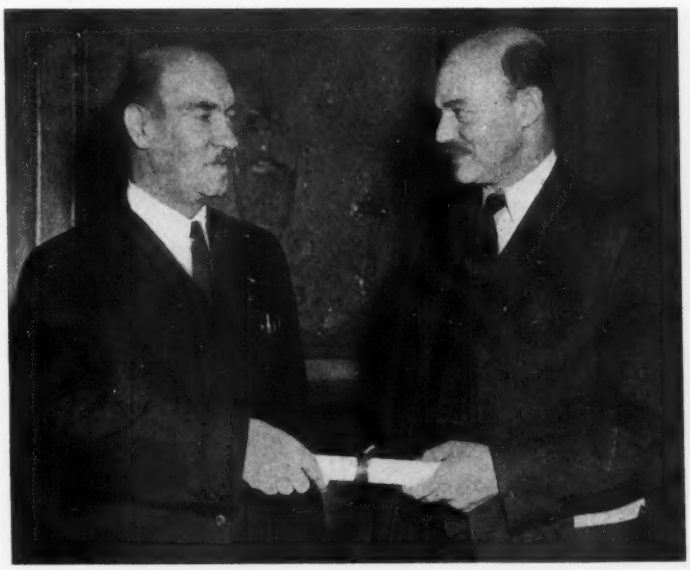
DR. HUNSAKER: Igor Sikorsky's experimental laboratory model of the helicopter grew in 1941 to be a flying machine of doubtful but very suggestive practicability. It established a world endurance record, for a helicopter, of one hour and thirty-two minutes in June of 1941. It was not the first helicopter to lift into the air, but I think it was the first helicopter to have adequate control.

In 1942 Sikorsky simplified and perfected the control. He introduced a novel sectional pitch control on the main or lifting propeller to govern pitching and rolling. There is an auxiliary propeller for steering and torque balance. As a result of this, he has a flying machine with control even better than that of an airship. It can hover, go ahead, it can back up, lift, come down, or move to one side.

The development from now on is, of course, unpredictable, except that we may be sure that it will be important to everyone in this room.

The Fellows of the Institute also had a secret ballot as to which one of our members should be given the highest professional distinction for 1942, to be made an Honorary Fellow. They voted for Sikorsky.

MR. IGOR I. SIKORSKY: Let me express my deep and sincere appreciation and thankfulness for the honors that have been bestowed. The helicopter is a very novel type of aircraft. It is a machine which, while useful even in the present military emergency, is still



Igor I. Sikorsky (*left*) accepts the Sylvanus Albert Reed Award for 1942 from Dr. J. C. Hunsaker.

How do temperature changes affect linear thermal expansion of Du Pont "Lucite"?

More data on Du Pont "Lucite" methyl methacrylate resin sheeting for aircraft designers, engineers and their established enclosure suppliers.

IT IS IMPORTANT that allowance be made for thermal expansion and contraction of plastic airplane enclosures subjected to wide changes in temperature due to altitude and geographical location.

The coefficient of thermal expansion of "Lucite" differs so widely from those of metals commonly used in mounting structures that suitable adjustment of design is necessary. For instance, the linear thermal expansion of "Lucite" is 3 times that of aluminum . . . 8 times that of steel . . . and 10 times that of glass. A differential expansion of as much as 0.006 inch per linear inch may occur in the plastic at the extremes of temperature experienced by military aircraft. See graph and table (Fig. 1) for values of increase and decrease in length of cast "Lucite" bars over the temperature range of −80°C. to +75°C.

FIG. 1

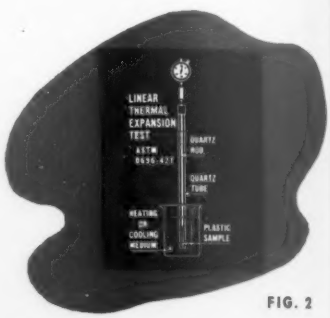


FIG. 2

METHOD OF MEASURING THERMAL CHANGE OF "LUCITE"

Du Pont technicians measured temperature effects on the length of "Lucite" using a quartz dilatometer, consisting of a 24-inch vertical tube of fused quartz, of 1/8 inch i.d., closed at its lower end (Fig. 2). A sample of "Lucite" 3.74 inches long was placed in the tube, followed by a rod of fused quartz. The rod rested on the sample and transmitted changes in the length of the test bar to a dial gauge.

The lower end of the apparatus was placed in a container of liquid. Expansion and contraction measurements were obtained by heating the liquid electrically, and cooling with "dry ice." Results of tests applying this method of measurement were used to construct the curve of the graph (Fig. 1).

SEE THIS MANUAL FOR MORE DATA

Due to the linear thermal expansion of "Lucite," proper methods of mounting and installing enclosures of the plastic are very important. The 114-page aircraft Manual on "Lucite" includes detailed information on this subject . . . also on fabricating, forming, repairing and general properties of "Lucite." Get your *free* copy. Write on your business letterhead to E. I. du Pont de Nemours & Co. (Inc.), Plastics Department-R, Arlington, N. J., or 5801 South Broadway, Los Angeles.

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METHYL METHACRYLATE RESIN

Better Things for Better Living . . . *Through Chemistry*

essentially a machine for peaceful service, for saving life and for serving ourselves in the future.

It is a machine with a number of very interesting characteristics, perhaps the only one that could be flown in this room safely and under good control, the most pleasant aircraft in which I have ever been in the air, and the machine which, to my mind, will play a very immense and very useful role in the future.

The John Jeffries Award

"For outstanding contributions to the advancement of aeronautics through medical research."

Honoring the memory of Dr. John Jeffries, an American physician who, with Blanchard the French balloonist, made the first aerial voyage across the English Channel in 1785 and on a previous voyage made the earliest recorded scientific observations from the air, this award was established by the Institute in 1940 to give recognition to the importance to aviation of scientific endeavor in the field of medicine. The Committee of Award has selected to receive this award for 1942

Edward C. Schneider

"For pioneering research in the field of aviation medicine, with particular reference to the development of the Schneider Physical Fitness Index."

PRESIDENT HIBBARD: Aviation medicine has had such an ever increasing influence on aeronautical development that the Institute established, three years ago, an award to recognize achievements of medical officers. There is no one who could more appropriately make this presentation than the Chief Medical Officer of the Army Air Forces, General Grant.

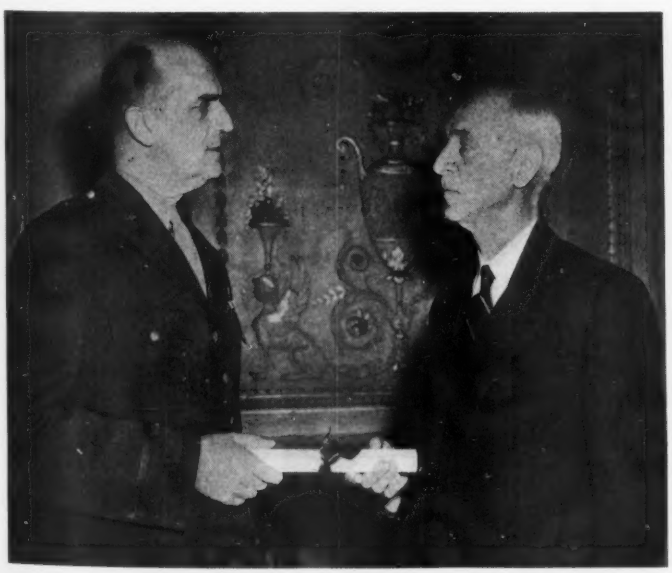
BRIG. GEN. DAVID N. W. GRANT: The Schneider Physical Fitness Index has been and is now being used as a part of every physical examination given for flying, both in the armed services and civilian life, with no change in its procedure or evaluation over the past 25 years.

Dr. Schneider has been honored by many institutions and is respected throughout the world by those who deal with the physiologic problems of flight. He has long had the habit of living and working at heights unfamiliar to most mortals.

Before there were enough fliers to justify a science of aviation medicine, he studied the behavior of men on mountain tops. Thus he came to his duties in the last war familiar with the biologic problems of high altitudes. From those youthful days on Pike's Peak to the present time he has devoted himself with remarkable constancy of purpose to a series of problems all of which are pertinent to the flying man. His test for physical fitness is but one contribution from a long and distinguished scientific career.

He has continually emphasized that physical well-being is necessary for those who would meet the stress imposed on the human body by modern aircraft. Thus, he has contributed immeasurably to the art of flying.

It is fitting that the John Jeffries Award should go to one who has done so much to enable men to fly the machines your engineering members have designed.



Dr. Edward C. Schneider (*right*) receiving the John Jeffries Award for 1942 from Brig. Gen. David N. W. Grant.

DR. EDWARD C. SCHNEIDER: I was privileged to see this branch of aviation medicine conceived, to participate in the foundational researches and, finally, to have a part in the instruction of the first class of medical officers who were to go out to the airfields as service flight surgeons.

I believe that the first spark that started the course of events that led to the organization of a school for the training in aviation medicine came to General Gorgas in 1917.

On October 18, 1917, General Gorgas appointed a medical research board of five members, four of whom were in the Army at that time. The four were Majors John B. Watson, psychologist; E. R. Lewis, otologist; William H. Wilmer, ophthalmologist; and E. G. Siebert, secretary. Prof. Yandell Henderson, physiologist at Yale University, School of Medicine, was added in civilian capacity and was made Chairman of the Board.

The general purpose of this board was the study of the effects upon the aviator of peculiar conditions involved in flying. Previous investigations, from those of Paul Bart in 1865 down to those on Pike's Peak had demonstrated clearly that the essential element in the effect of high altitudes was the reduced partial pressure of oxygen. That the same thing would hold true of the functional disturbances of the aviator furnished a fair presumption from which to start investigation.

In 1917 I went to Washington to supervise the developments of low-oxygen tests for aviators and later to supervise their examination on a large scale. Prior to this, beginning in 1908, I had been investigating the physiologic reactions of mankind to high altitude in Colorado Springs, at 6,000 ft., and on Pike's Peak at an altitude of 14,110 ft., and I had also been a member of the Anglo-American Expedition to Pike's Peak.

By the middle of November, in 1917, a small group of three psychologists were conducting, in a temporary laboratory in Washington, experiments with a rebreathing apparatus designed by Dr. Henderson. This was to determine the ability to withstand low oxygen. We were fortunate in finding men who differed markedly in their response to a steadily decreasing amount of oxygen and, hence, early in December we were requested to make a demonstration before a group of ten high-ranking Army

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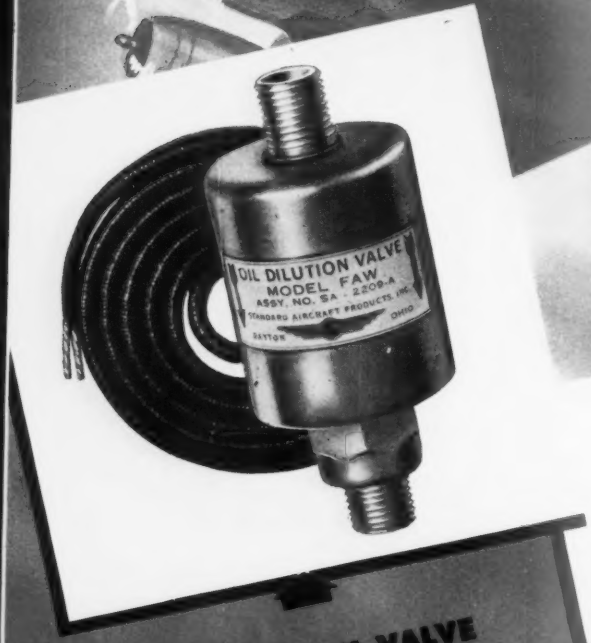
OIL DILUTION and PRIME

These precision controls, as well as other Standair instruments, are being specified for, and are proving their dependability daily in the military aircraft of the United Nations. Write or wire for complete engineering details.



OIL DILUTION VALVE

This valve is an electro-magnetic valve designed primarily for the dilution of engine oil with gasoline to facilitate easy starting in cold climates, but may be used in conjunction with any accessories requiring up to 100 p.s.i. straight through valve. It can be furnished for any voltage. Weight, 12½ oz. Overall dimensions, 1-9/16" diam. x 3⅝" long.

FUEL TANK PRESSURE CONTROL VALVE

This Aneroid Valve prevents vapor lock by maintaining the correct pressure in the fuel tank for all flight conditions. It incorporates relief mechanism for excessive tank pressure and safety release for any tank vacuum. Weight, 1 lb. 2 oz. Overall dimensions, 4¼" x 5".

STANDAIR

STANDARD AIRCRAFT PRODUCTS, INC.

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officers. This demonstration convinced the group of the value of such a test.

In the meantime, plans for the erection of a laboratory on an airfield and the constructing of a large decompression chamber were under way. By the middle of January, 1918, the investigators were transferred to Hazelhurst Field, Long Island. There, a test of classification of men according to their ability to withstand the effects of high altitudes was finally perfected.

The training of crews of workers to apply the test began, and as soon as they became efficient these men were sent to flying fields throughout the country to classify the pilots and observers.

Expansion of the force of research workers soon included cardiologists, otologists, ophthalmologists, psychiatrists, psychologists, and physiologists.

It was found that the nervous system of pilots was subject to a terrific strain, and that only men with a healthy nervous and psychic make-up tolerated flying for long. It was also observed that physical efficiency was of exceeding importance. Hence, studies were made of the effects of flying over long periods of time.

By the middle of March, 1918, a school for the training of flight surgeons was created by an order from General Gorgas. Thus, the medical research laboratory personnel was called upon to teach physicians and properly equip them to go out to live with and care for the aviators.

It is of interest to record that some of the doctors sent to the laboratory for this purpose arrived the same day that the order to establish a school for flight surgeons came from Washington. Colonel Wilmer, then commandant of the laboratory, ordered me to arrange the curriculum, and thus began the development of schools of aviation medicine, and today both the Army and the Navy have schools that are training flight surgeons.

It should be here recorded that the honor of placing the first school on a permanent basis goes to Dr. Louis H. Bauer. I had the rare privilege of working with him for almost seven years, and thus know from close observation how able and kind was his leadership.

The Robert M. Losey Award

"In recognition of outstanding contributions to the science of meteorology as applied to aeronautics."

Established in 1940, this award honors the memory of Capt. Robert Moffatt Losey, a member of the Institute and a meteorologic officer of the Air Corps, who was killed at Dombas, Norway, April 21, 1940, while serving as an official observer for the U.S. Army. He was the first officer in the service of the United States to die in the present World War. The award for 1942 was conferred upon

F. W. Reichelderfer

"For pioneering work and continuing activity in advancing the science and practice of meteorology as applied to aeronautics, with particular recognition of the development under his direction of the network and system of upper air sounding by radiosonde."

PRESIDENT HIBBARD: Probably no one has done more for the Institute without receiving the credit that is due him than Charles Colvin. It was he who interested Paul Kollsman in the creation of the Lending Library. As Treasurer and in many other ways he has rendered invaluable services to the Institute. He has for the past three years been acting as advisor to the Weather Bureau in the development of new weather instruments, and therefore he can tell you why the Losey Award is presented this year to Commander Reichelderfer.

MR. CHARLES H. COLVIN: Commander Reichelderfer came to the Weather Bureau with 20 years of experience in meteorology and aviation experience, which served him and us in aviation very well indeed.

Under his direction and guidance a network of some 50 radiosonde stations has been established throughout the continental United States and Alaska. These stations send their little instruments twice each day into the upper atmosphere. They rise from 12 to 15 miles and automatically and continuously send back by radio their reports of pressure, temperature, and humidity. These radiosonde stations have been supplemented by about 125 pilot balloon stations at which observations are made of winds at flight levels. In addition to that, the Weather Bureau now has, under Commander Reichelderfer's direction, about 650 surface airway weather reporting stations and, along with the establishment of these new facilities in the field, the central office of the Weather Bureau in Washington has been reorganized to adapt itself to aviation requirements.

Since the inauguration of the Defense Program and, more especially, since our entry into the War, the great body of professional civilian meteorologists which comprise the Weather Bureau organization have, under Commander Reichelderfer's direction, made contributions to the war effort not exceeded by those of any other civilian agency.

Commander Reichelderfer, as one who has had the great privilege of working for you in the Weather Bureau, I take a very special personal pleasure in handing you the Losey Award for 1942.

Charles H. Colvin (*left*) presenting the Robert M. Losey Award for 1942 to F. W. Reichelderfer.

Emphasis on magnesium at present rests on its use in constructing airplanes. Vast quantities of this lightest of structural metals, extracted by Dow from ocean water and Michigan brine, are devoted to that purpose. But as a weight-saving metal, magnesium faces an even greater era of usefulness. Imagine the countless peace-time applications when production and facilities for fabricating Dowmetal castings and wrought products are available for general purposes! It is a prospect that intrigues every forward looking designer.

DOWMETAL

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MAGNESIUM

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COMDR. F. W. REICHELDERFER: We may all feel some satisfaction in the progress meteorology has made in the last decade or two, but there is much yet to be done. The job cut out for weather service by that modern wonder, aeronautics, is enormous. In the last analysis, the aeronautical engineer, the air transport operator, the dispatcher, the pilot would like to be able to forget all about the weather. As aircraft performance and navigational aids are improved, air commerce is in one respect becoming more independent of weather; but when the refinements of operating efficiency and passenger comfort are brought back into the picture, we again see the need for weather information.

For aeronautical purposes, there is only one ideal solution: "Control" the weather. Since that is impossible, we need a time table giving the schedule of every storm, every atmospheric obstacle to air navigation, days in advance, so that schedules can be planned accordingly. You all have reason to know the complexity of the problem.

Gradually, we shall obtain more and more exact knowledge of the atmosphere, and uncertainties of the weather will be reduced. How rapidly we approach that goal depends on how much we put into it in the form of research, organization, and intelligent use of available services. We can be sure that the present tempo of aeronautical development is being accompanied by a similar speedup in aeronautical meteorology.

Global air transport during and after the War must carry with it global collaboration in meteorologic organization and service.

A few years ago we had a few hundred meteorologists in this country. Now we have thousands. A few years ago we spent a few thousand dollars annually in research in meteorology. Now the amount is many times that much.

I think we can risk a forecast. I think we can look to the future with confidence, and, seeing the impetus given to meteorology by aeronautics and by the War, we can say that in days to come the nuisance coefficient of the weather will become less and less because your meteorologist will be able to tell you more and more about what to expect in the weather.

The Octave Chanute Award

"For a notable contribution made by a pilot to the aeronautical sciences."

This award was established by the Institute in 1939 to honor the memory of Octave Chanute, pioneer American aeronautical investigator and glider pilot, who died in 1910. The recipient of the certificate of award, chosen by the Committee of Award in 1942, was

A. Lewis MacClain

"For outstanding work in the flight testing of aircraft engines and the development of the engine torque indicator."

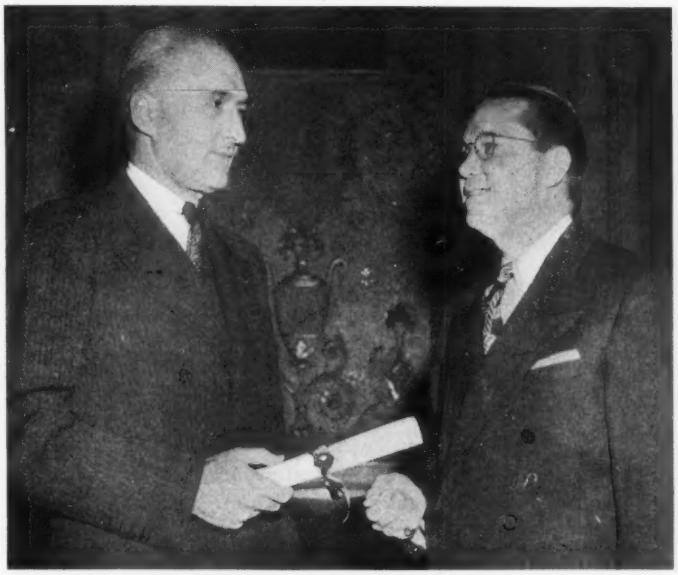
PRESIDENT HIBBARD: How can anyone introduce Casey Jones to any aeronautical gathering? You all know him as a great pilot in the good old days who has now become Prexy to thousands of young men who wish to emulate the career he has made so notable.

MR. C. S. JONES: The Octave Chanute Award is given for a notable contribution made by a pilot to the aeronautical sciences. It offers an incentive and encouragement to a group of people who richly deserve it and who, I might say, have very seldom received it. If we review the history of test pilots, we see that it goes back to the old days when the Wright Brothers, Curtiss, and Glenn Martin and some of the others started to fly. They were primarily mechanics, then they were engineers and, finally, they were test pilots, primarily, I believe, from necessity rather than choice.

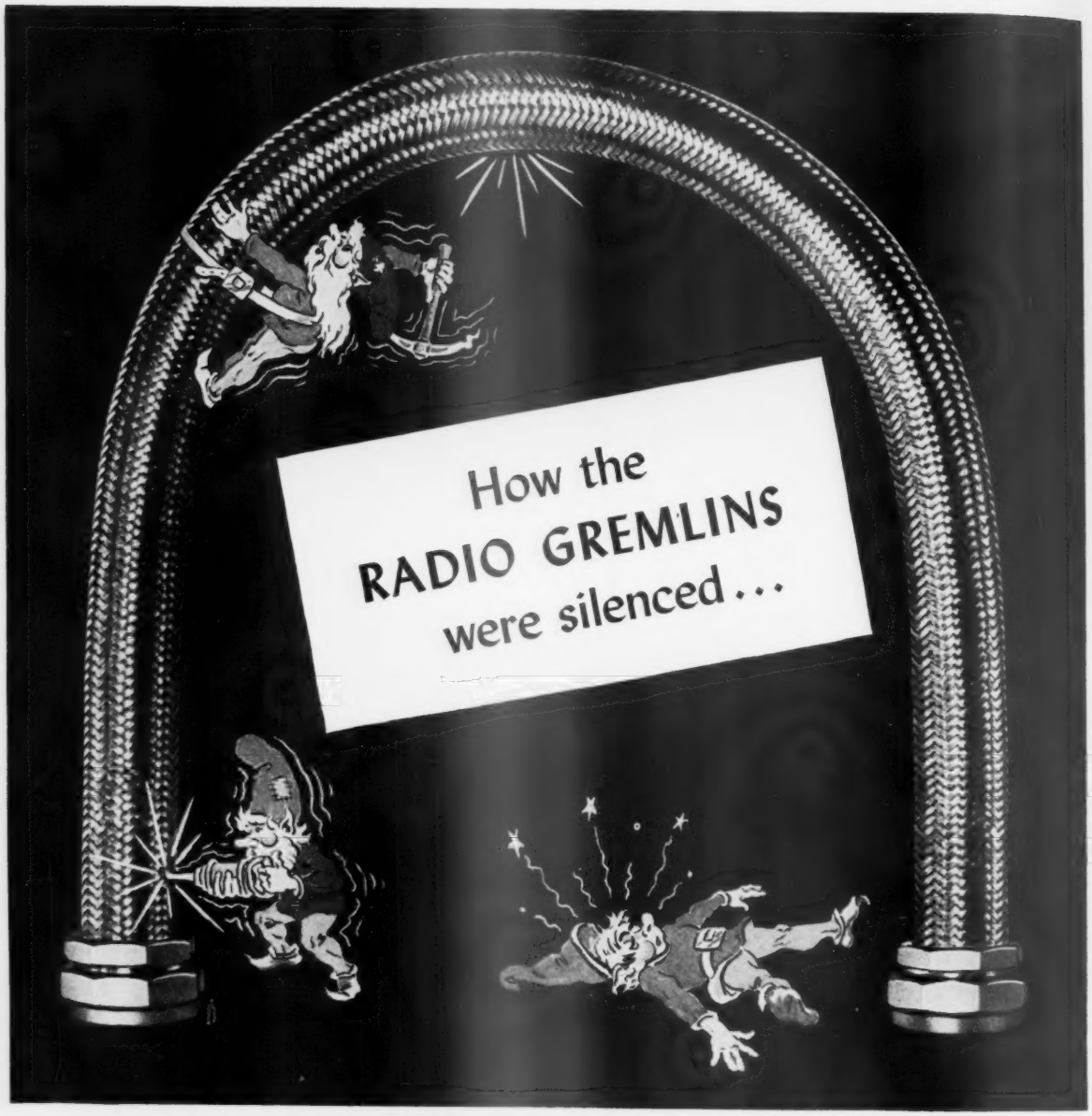
If a test pilot could wear a big belt around him and stand 9-G and pull the wings off and do everything else, he was really good. The Army Air Corps stabilized test piloting. They gathered a group of pilots who were not only the best pilots we had but who also had engineering training, and they worked out a formula for testing airplanes, and gradually industry has come to the rea'ization of its importance.

MacClain has been a test pilot for fifteen years. It requires skill as a pilot and that little extra something that is able to convert from the piloting angle to the engineering board the results of his effort.

MR. A. LEWIS MACCLAIN: I receive this award with a great deal of gratitude, but most of it should go to the associates with whom I worked who developed the instrument. I just took it up and flew it. I am in agreement with the signs we see: "You build them and we'll fly them."



Hall L. Hibbard (*right*) congratulates A. Lewis MacClain on receiving the Octave Chanute Award for 1942.



THESE insidious nonentities raise hob with pilots' nerves, chattering sing-song misdirections, playing tag among the instruments, and generally making vicious nuisances of their mysterious selves.

One place they haven't been so successful with their mischief, however, is in the radio instruments, mainly because of Flexible Low-Tension Shielded Conduit that won't permit their sly whisperings and those distracting and interfering static-induced noises to get to the pilot's ears.

With the foolproof protection of Flexible Low-Tension Shielded Conduit, United Nations' flyers hear their radio signals and directions clearly, unfailingly.

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Edward C. Wells (*left*) receiving the Lawrence Sperry Award for 1942 from Frank H. Russell.

The Lawrence Sperry Award

"For a notable contribution made by a young man to the advancement of aeronautics."

This award was endowed in 1936 by the brothers and sister of the late Lawrence Sperry, pioneer aviator and inventor who died in 1923 at the age of 31. It provides an annual certificate of citation and honorarium of two hundred and fifty dollars to the recipient selected by the Board of Award. Their choice for 1942 was

Edward C. Wells

"For outstanding contributions to the art of airplane design with special reference to four-engined aircraft."

PRESIDENT HIBBARD: And now we bring together two extremes. Frank Russell was the first manager of the Wright Brothers' first airplane factory. From that beginning he has been continuously identified with the aeronautical industry, always as a leader. Tonight the representative of the entire history of aviation in this country will make the award that the Institute gives annually to a young man who makes a valuable contribution to aeronautics.

MR. FRANK H. RUSSELL. I knew Lawrence Sperry for a great many years, from the day when he conceived the idea of building an airplane runabout, an airplane that he could jump into and fly.

I remember very well Lawrence landing on the street in Garden City, in front of my office, coming in to tell me of some new idea he had. On another day he would take his little "Messenger" and fly down to the President and see him, landing possibly on the White House lawn.

Years later he took the "Messenger" over to Europe and he flew it on a political campaign enterprise for Lloyd George. On his way, having done that job, he wanted to fly it over to France, and he flew it across the Channel. When he was a mile and a half off shore, very unfortunately the motor failed him and he made a forced landing. The water was very cold. It was in December, 1923, and he was drowned trying to swim ashore.

The Board of Award for this year selected to receive the award Edward Curtis Wells. Mr. Wells graduated from Stanford University and Willamette University, and then got a job, and unlike almost any other aviation man I know of, he has been continuously for thirteen years on that one job, but not the same job, simply with the same company. He has gone in an ascending spiral of more important positions every year, until today he is the Assistant Chief Engineer of the Boeing Company.

For eight years he worked on an idea of his, a large, four-motored airplane. The B-299 was the result of it at first. It was changed then to B-17, and that machine has been continually improved since then.

The flying Fortress—I suppose there is no machine in America built by any company that is as popularly known and possibly more rightfully known than the Flying Fortress. Twenty years after Lawrence Sperry took his "Messenger" over to Europe, the Flying Fortress went over there and, as we know, has struck terror in the hearts of our enemy and has been itself a messenger of hope for all Allies and subjugated peoples.

MR. EDWARD C. WELLS: I have been happy to have had a part in the development of the present-day four-engined airplane. It is my hope that I can continue with that development and that some of the later four-engined airplanes that result will also do credit to this country.

Honorary Membership in the Institute

The Council confers Honorary Membership in the Institute upon the officials in charge of certain governmental activities concerned with aviation. The following were elected Honorary Members during the past year:

REAR ADM. JOHN S. MCCAIN
Chief of the Bureau of Aeronautics, Navy Department

W. A. M. BURDEN
Special Aviation Assistant to the Secretary of Commerce

T. P. WRIGHT
Director, Aircraft Resources Control Office, War Production Board

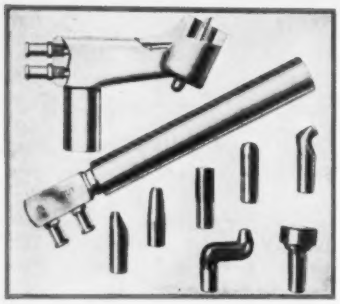
PRESIDENT HIBBARD: The Institute adds to its list of Honorary Members each year and usually it is to those who are rendering distinguished service to Government aviation. You have heard from two of those whom we have honored this year. Mr. Wright, you deserve this honor not only for the great service you are rendering the Government but for the many years of distinguished service to aeronautical engineering.

Mr. Burden, we make you an Honorary Member of the Institute not only for your able direction of Civil Aeronautics but for your generous and farsighted assistance to the Institute.

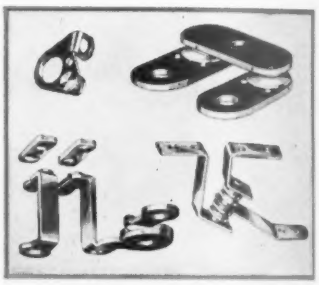
The third Honorary Membership goes to Rear Admiral McCain. We had hoped that he could have been with us tonight to tell us of the remarkable achievements of naval aviation in this War, but at the last moment he was prevented from coming. Instead, he designated an old friend of the Institute to receive it for him. Whenever you see that blue ribbon dotted with stars, you know that the officer who wears it received the Congressional Medal of Honor for an act of heroism far beyond the call of duty. Captain McDonnell is Commanding Officer at

MALLORY PARTS are Precision Parts

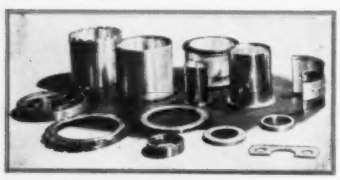
Mallory services to the aviation industry have expanded their scope enormously. More and more aviation engineers are turning to Mallory while designs are still in the blueprint stage. They have learned that Mallory quality and Mallory experience insure dependable performance.



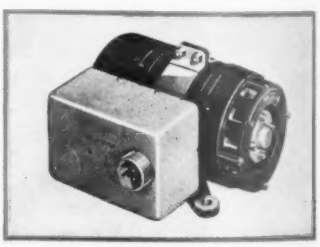
MALLORY Resistance Welding Electrodes and Holders: Mallory Standardized Spot Welding Tips and Holders, Mallory Seam Welding Wheels and Mallory Dies for flash or butt welding are speeding fabrication of aluminum, aluminum alloys, stainless steel and other metals in practically all leading aircraft plants. Mallory supplies specially developed electrodes that produce more welds between dressings . . . need replacement less often . . . and assure sound, clean welds at high production speeds . . . at lower cost. Write for the Mallory Resistance Welding Data Book.



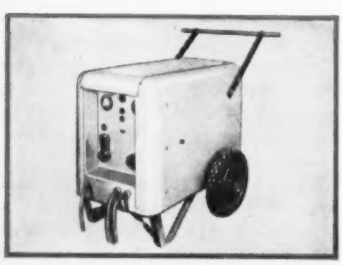
MALLORY Electrical Contacts and Contact Assemblies: Made of many different Mallory-developed alloys and pressed powder materials, these contacts and contact assemblies are used to actuate a modern airplane's electrically controlled apparatus . . . from retractable landing gear to variable pitch propeller. Mallory Contact Assemblies can save you production time when you need quantities of any given type of aircraft relay *fast!* The Mallory Contact Data Book is an invaluable aid—we will send it on your request.



MALLORY Bearings are made by Mallory's Mallosil* Process of bonding silver to base metal backings. They provide a tough, homogeneous, heat-dissipating silver surface of high fatigue resistance; ample strength and hardness; and high resistance to seizure. Mallory has set remarkable records for exactness and uniformity in producing bearings, bushings, pinion races, gear races and other aircraft engine parts.



MALLORY Noise Filters: Used in aircraft to suppress the static caused by spark-plugs, electric motors, inverters and other electrical equipment . . . and thus to assure clear communications.



MALLORY Approved Precision Products: This term also applies to the many kinds of electronic equipment and parts made by Mallory for the aircraft industry's use. For instance, Rectostarters*. . . portable or stationary rectifier units . . . are used for testing aircraft electrical apparatus, for charging batteries in airplanes and in airplane plants, for starting "green" engines, etc. Also, condensers, volume controls, switches, vibrators, Vibrapacks* (vibrator power supplies), jacks, plugs and other electronic parts . . . made to high precision standards by Mallory . . . are used in aircraft and airport communications systems, in aircraft laboratories and plant control equipment.

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Rear Adm. John S. McCain.

the Naval Air Station at old Floyd Bennett Field and a distinguished pilot.

CAPT. EDWARD O. MCDONNELL, U.S.N.: It is very unfortunate that Admiral McCain could not be here tonight. I am sure that he could have rendered an interesting account to you of how our combat pilots of the Navy in different parts of the world are using the aircraft that you men have designed and built.

In accepting the award as a representative of the Naval Air Service, I assure you that Naval Aviation is deeply grateful for the distinction that you have paid to our Chief.

PRESIDENT HIBBARD: There is in all countries a select group in various fields who admit to their number new members for pre-eminent achievement. In aeronautics the Fellows of the Institute represent those whose careers have been those of outstanding achievements and are so recognized by their associates. If the newly elected Fellows will come to the dias, I shall give them their certificates.

Fellowship in the Institute

The distinction of Fellowship may be conferred upon not more than ten Associate Fellows of the Institute each year. They are elected by ballot of the present Fellows and Honorary Fellows, who chose the following in 1942:

FREDERIC FLADER
Chief Engineer, Airplane Division (Buffalo Plant), Curtiss-Wright Corp.

RUDOLPH F. GAGG
Assistant to the General Manager, Wright Aeronautical Corporation

PAUL E. HOVGAARD
Chief Research Engineer, The Glenn L. Martin Company

CLARENCE L. JOHNSON
Chief Research Engineer, Lockheed Aircraft Corporation

ARTHUR L. KLEIN
Associate Professor of Aeronautics, California Institute of Technology; Consulting Engineer, Douglas Aircraft Company

JOHN G. LEE
Assistant Director of Research, United Aircraft Corporation

WILLIAM T. SCHWENDLER
Vice-President and Chief Engineer, Grumman Aircraft Engineering Corp.

T. E. TILLINGHAST
President and Director, United Aircraft Service Corporation

P. V. H. WEEMS
Lt. Comdr., U.S.N. (Retired); Weems System of Navigation

JOHN B. WHEATLEY
Chief Development Engineer, The Glenn L. Martin Company

Induction of President Dryden

PRESIDENT HIBBARD: And now I come to the end of my year of service to the Institute as its President. I wish to express my appreciation to the officers, to the Council, and to the members for their support and cooperation. It has been a rare privilege to see the Institute progress as it has, and I am confident that it will continue to grow in influence and prestige.

We have had scientists as Presidents, like Drs. Hunsaker and Millikan. We have had two great aircraft constructors, Glenn L. Martin and Donald Douglas. Two distinguished engineers, T. P. Wright and Frank Caldwell, have had their years. We have had as President a famous pilot, General Doolittle. Earlier this year he received the Daniel Guggenheim Medal.

Next year we will have as our leader a world-famous aeronautical scientist. His research work in many fields of aeronautics has resulted in contributions which have enlarged our boundaries of knowledge. I am particularly gratified that the last duty I have is to turn the direction of the Institute over to Dr. Hugh L. Dryden.

PRESIDENT-ELECT DRYDEN: To serve the Institute of the Aeronautical Sciences in any capacity is a great privilege. To serve as its President is an outstanding honor. My distinguished predecessors have set an exceptionally high standard. Under their guidance the Institute has grown in numbers from a small group to over 5,000 members and in prestige from a struggling infant to a leading scientific society. Unique in housing within one Institute the outstanding contributors to the basic aeronautical sciences, the foremost designers of aircraft, the most prolific builders of aircraft, and the leading pilots of the country, the Institute of the Aeronautical Sciences exerts through its members a tremendous influence on the technical progress of aeronautics and, hence, to use our new adjective, on global affairs.

The purposes that motivated the founders of the Institute, to advance the application of science to aeronautics, to publish technical papers, and to meet for the discussion in common problems, are of increased importance under present-day conditions.

Though some adjustment of methods is necessary, the winning of the War depends on continued leadership in fundamental science and in the rapid application of old and new scientific knowledge to the design and production of aircraft.

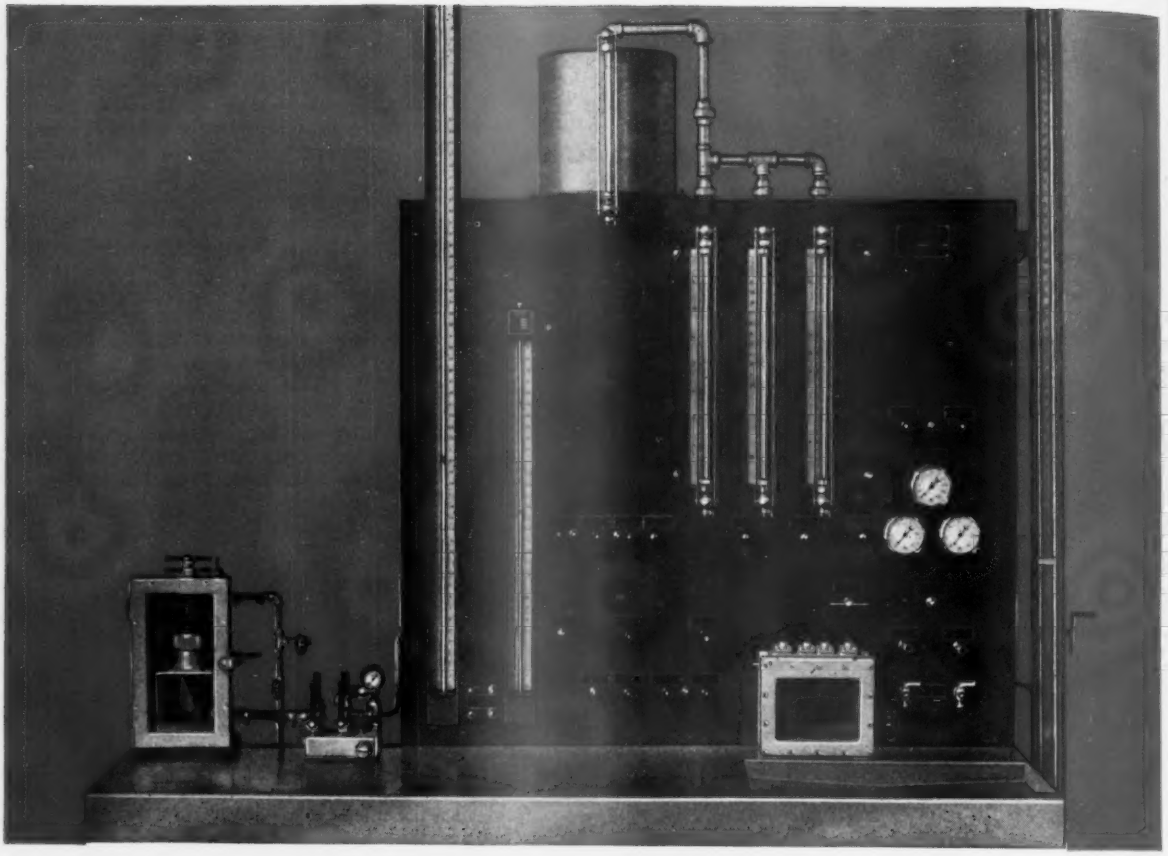
Dr. Hugh L. Dryden.

The Institute now, as in the past, proclaims the urgent necessity of scientific research and development, as well as production and through its system of honors and awards will continue to stimulate individual initiative on which original contributions depend.

Publication of our own new developments must, of necessity, be restricted during the War, but a wider publication of technical information from many enemy sources can serve a useful purpose.

The coming of thousands of newcomers to the industry gives rise to the needs for interpretive review and summary articles containing the highlights of scientific studies now familiar only to the experts. Without a meeting of engineers to discuss common problems, progress is likely to be erratic.

It is a challenge to all of us to discover how to share knowledge under wartime conditions with greater benefit to our own aeronautical industry and greater harm to the enemy. I have the greatest faith in the aims of the Institute.



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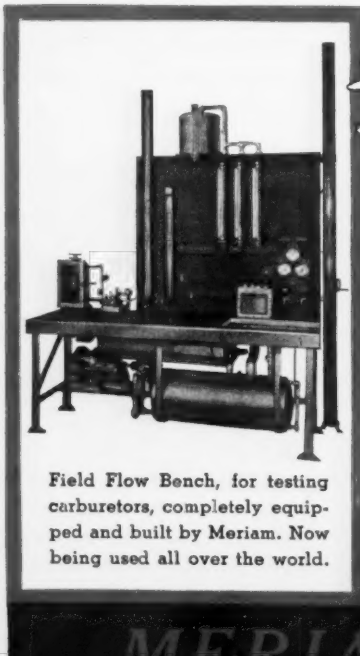

Field Flow Bench, for testing carburetors, completely equipped and built by Meriam. Now being used all over the world.

This flow bench, built for the manufacturer of Stromberg carburetors, is completely equipped with Meriam Manometers. The test unit is primarily used for field testing and proving aircraft carburetors after overhaul.

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Air Cargo Today and Its Influences in the Postwar World

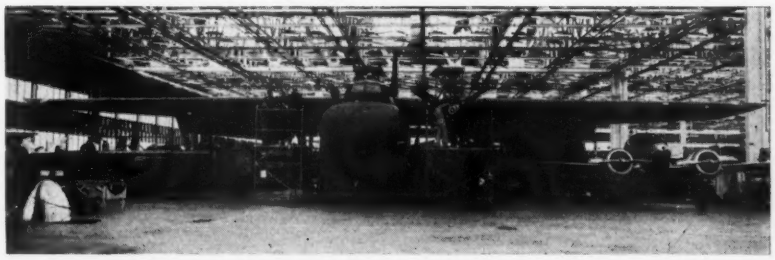
L. WELCH POGUE*†
Civil Aeronautics Board

IN SPEAKING on air cargo today and its influences in the postwar world, false emphasis would result if one talked at equal length about the present and the future. At the present time, air cargo is but a guide to the problems and a harbinger of the possibilities of its future. It stands as the great unmeasured potentiality of air transportation, just as air transportation stands as the new and measureless potential force in our national economy and international relations.

The Civil Aeronautics Board and the air carriers compute the volume of air express in terms of pound-miles carried. The growth has been amazing. From two and three-quarter billion pound-miles in 1936, the carriage of air cargo in the United States has grown to over seventeen and one-quarter billion pound-miles in the most recent twelve-month period.

Those seem to be colossal figures in keeping with the times, but put them in perspective. In the recent release of the National Resources Planning Board, "Transportation and National Policy," there is an estimate made of the total inland intercity freight traffic for the year 1939. That estimate is 536,755,000,000 *ton*-miles, or over one quadrillion *pound*-miles. Air cargo and mail pound-miles together in 1939 were only $^{2}/_{1,000}$ of 1 per cent of that total. Within the limitations of statistics, that states at once the place of air cargo today and suggests the scope for air cargo tomorrow in the domestic field alone.

In surface transportation cargo has always been the principal source of revenue. This has not been true of air cargo and air transportation. For the twelve months ended June 30, 1942, the four and one-third million dollars revenue derived by the domestic air lines from cargo carriage compared with seventy-five and three-quarter million dollars revenue derived from passengers. Cargo revenue was only 4.15 per cent of their total operating revenues of 105 and three-quarter million dollars. Air cargo is simply a fledgling by-product of the other services of the air lines—an untapped potentiality that may, in its development, overshadow in importance everything in commercial aviation.



The giant Curtiss (C-76) Caravan, now nearing completion. Built almost entirely of wood and other nonstrategic materials, the new "air freighter" is a high-wing monoplane, has a wing span of 108 ft., is 68 ft. long, and is powered with two 1,200-hp. engines. No details on its performance or cargo capacity have been released.

Air-Cargo Developments

Such is commercial air cargo. At the present time, the Air Transport Command of the Army Air Forces and the Naval Air Transport Service are utilizing airplanes to transport supplies and munitions to all our Allies and battlefields in this global war and to bring to this country strategic materials of war. The air lines are operating many of their own and many of the Army's and Navy's planes in this military cargo transport service. Exact performance figures are a military secret, but the tonnage of vital supplies which is being carried is adding mighty striking power to the military forces of the United Nations. America, founder of aviation, supreme in the air in peace, is proving to the startled German Reich, to the still-declining Roman Empire, and to the Setting Sun of Japan that it can rule the air in war.

Prior to the outbreak of the war, significant developments of volume of air cargo were taking place in Alaska, Canada, Poland, Russia, and Sweden. T.A.C.A., in Central America, supporting itself largely by the carriage of over 20,000,000 lbs. of freight a year, has received world-wide attention. In New Guinea, a town of over 15,000 people located in the Morobe gold fields was being supplied by air with all its needs, from mining and dredging machinery to motor cars, trucks, horses, cattle, and building and other heavy materials. During 1938, the average weight of cargo and mail carried to this community was 32 tons per day. These are exceptions to the fact that world-over the development of air cargo has been limited.

The Future of Air Cargo

If this is the present, what then is the future of air cargo? Unless there is a great expansion of air cargo, the full potential of air transportation will not be realized. As an illustration in a recent article, three estimates were made as to the number of passengers which might be carried on the domestic air lines in the future. The realization of the highest estimate for the 1975 peak, 42 times recent levels, would require only about 8,000 planes of present DC-3 capacity. This is a large number of aircraft when compared with the 350 which the domestic air lines had shortly before the outbreak of war. It falls far short of providing the tens of thousands of planes which may in the future be required in an instant for our national security. If such numbers of planes are to be maintained in the future as an auxiliary wartime reserve and are meanwhile to be placed in economic service, they must be used in the carriage of air cargo.

Air Versus Rail Transportation

To extend the appraisal of the importance of air cargo in air transportation, in our national economy, and in world politics, an interesting speculation can be made with some of the statistics showing the relative importance of passengers and freight on the rail-

*Chairman.

†Acknowledgement with thanks is made of the assistance of R. B. Adams, of the Board's staff, in the preparation of this paper.

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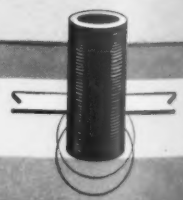


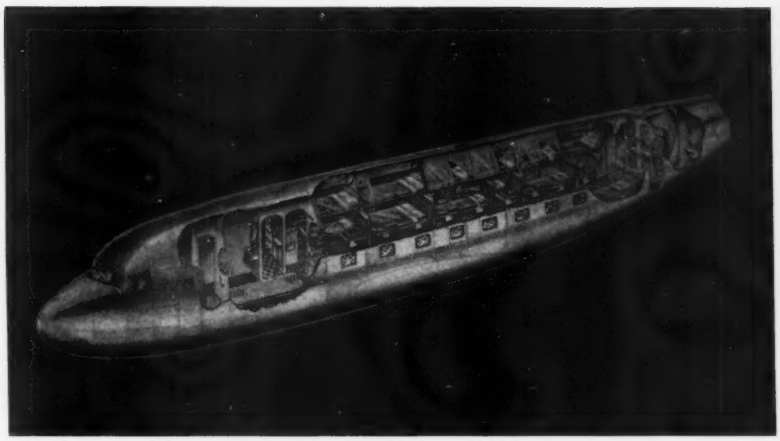
roads. Please keep clearly in mind that it is neither claimed nor suggested that air transportation will duplicate the experience of the railroads in that respect. Air transportation differs from rail transportation in so many ways as to make rail experience of dubious value in prophesying in the field of air transportation.

In 1940 the railroads carried 181 passenger-miles and 2,835 ton-miles of freight per capita. In a recent twelve-month period, the air lines carried eleven passenger-miles per capita but only $^{46}/_{1,000}$ of a ton-mile of air cargo per capita. If the air-lines' cargo ton-miles and passenger-miles per capita had borne the same relationship as existed between those two classes of traffic in 1940 on the railroads, they would have carried 176 ton-miles of air cargo per capita. This would have resulted in a total of twenty-three and one-quarter billion ton-miles and would have required between 30,000 and 40,000 planes of our present DC-3 type to handle. If there had been this number of planes in our domestic air-transportation system on December 7, 1941, there might not have been perpetrated on that day the most infamous national act in history.

Carry this speculation to the extreme. Assume that in 1975 fifty billion passenger-miles are being carried by air with the use of some 8,000 planes; technologic advances have made the airplane the new medium for the carriage of cargo; and something like a present-day railroad ratio between passenger-miles per capita and air cargo-miles per capita exists. Half a million planes of varying sizes would be required to handle domestic air-cargo needs. Such a fleet of planes, new creator of economic wealth, realization and symbol of the genius of the American people, of their commercial progressiveness, of their industrial power, would stand as a mighty instrument of international policy.

In appraising the importance of air cargo, for a moment the perhaps distant future has been sounded. What will air cargo be in our lifetime? The author must confess that he has been intrigued at times by the stimulating language that is being used to describe air cargo of tomorrow—"flying box cars," "sky trucking," "sky trains," and "flying freight trains." The implications of these envisionary terms are too great for the immediate future.

It should be clear that all the freight now being carried by railways, trucks, water carriers, and pipelines, is not going to be placed overnight in airplanes and carried to the far corners of this nation and the earth. The approximately seventy *million* dollar investment in the domestic air lines is not going to expand in a day to wipe out the twenty-five or thirty *billion* dollar investment in our railroad and trucking systems, nor will ships rot at their docks.



An early illustration showing projected passenger sleeping accommodations of the Douglas DC-4 (now the Army C-54).

It is true that there are probably few articles of commerce which have not been at some time or some place moved by air. Airplanes in this country have carried principally wearing apparel, newspapers, machinery, moving picture films, advertising, auto supplies, electrical products, valuable papers, and electrotypes. Here or abroad, however, planes have also carried canned goods, eggs, chicks, ice cream, cats, dogs, horses, bulls, gasoline, fuel oil, mining equipment, dynamite, furniture, autos, tractors, motor boats, wheat, and even lumber and coal. The author has read that the only thing which KNILM in the Dutch East Indies has refused to carry is a full-grown tiger. It is erroneous to believe that, because an airplane once carried a particular article of commerce, just as soon as a certain number of planes can be made available they will carry all such articles in commerce. Sound economics will continue to demand the services of railroads, trucking concerns, and other transportation.

Air-Cargo Rates

A measurement of the level of the airplane's greatest economic utility in the field of air cargo can be made at the present time in only the very broadest terms. Rail express rates have been estimated at from eleven to eighteen cents a ton-mile. Freight rates for railroads range from commodity rates of less than one cent a ton-mile for carload shipments to about seven or eight cents for first-class less-than-carload shipments. Freight is carried by trucks at a rate of three or four cents a ton-mile. The cost of ocean shipping is considerably less than that of carload freight. The present indications are that the planes most immediately available in the postwar world for cargo carriage will operate at a total ton-mile cost of not less than fifteen or twenty cents; some say ten cents. These possible costs for the carriage of air cargo have set men thinking.

Present air cargo rates are between eighty and ninety cents a ton-mile, several times rail express rates. Despite this, and in the face of the most modern efficient, diversified, and economical, surface-transportation system in the world, the air lines are approaching the carriage of twenty billion pound-miles of air cargo a year. Rail express rates are next above the peak of those of less-than-carload freight. What will happen when air-cargo rates hover above or equal those of rail express? Measure the value of time, of speed in transportation. Compute the many millions of dollars which may be saved for business when the speed of air transportation has reduced the necessity for large stock inventories. When these and other now-indeterminable values are measured, it will be possible to tell something definite of the volume of cargo which will be diverted from other forms of transportation when the rates are cut in half and then again cut in half.

Freight Tonnage

One of the largest railroads of the country has a staff report on air cargo in which it is stated: "Adding up these figures of potential high-grade freight tonnage, the total volume of merchandise suitable for air-cargo freight movement which has not yet been tapped, runs to 20,931,000 tons yearly. Of course, a substantial amount of this tonnage might never be diverted to air movement; nevertheless, the potential extent to which air competition can invade this mass tonnage of higher grade traffic should not be minimized." The report ends with the statement that but one conclusion can be drawn: "transportation of freight by air is on the way

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and will forcibly establish itself during the postwar era."

About this there can be no question: the extensive carriage of cargo by air is on the way. Drawing in the forseeable future upon the "high-grade freight tonnage," it will probably also draw some upon the cargo now carried by trucks. A progressive diversion of even something like half the limited amount of high-grade cargo now carried by our surface transportation system would be a significant achievement for air transportation. It might require a fleet of some 25,000 to 30,000 planes of various sizes. A pace in progress would be set for a world to follow. Considerations of national security alone may demand it.

While cargo now carried by other forms of transportation will be a source of business for air cargo, there should not be too much concern about this diversion. It will extend over a period of time sufficient to permit adjustments and replacements to be made, and the future of air cargo does not depend wholly upon it. It must be remembered that this is a rapidly advancing Air Age, and that air transportation and air cargo constitute a challenge to many of the established principles of transportation, economics, and world politics.

New Market Development

The extensive carriage of cargo by air in Central America and New Guinea has already been mentioned. In both places, surface transportation facilities are poor. In New Guinea, the trip by air took 25 min., while the trip by the only other available means of transportation would have required one week. These developments in Central America and New Guinea illustrate not only the speed but also the unique mobility of the airplane and its disregard of topography. Long years ahead of what otherwise would have been possible, air transportation and air cargo will bring into the channels of trade many of the products and the resources of the hitherto undeveloped regions of the earth.

Air cargo will create other new articles of commerce. Perishables that never before could find a distant market even in a refrigerator car will flow along the air-trade routes of the nation and the world. Others, full-ripened and full-flavored, will come to tables. The speed of the airplane, flying Great Circle courses and shrinking the world in size to a matter of hours, will enable this country for the first time to show with competitive promptness the merits of our products in the most remote markets of the world. Gauge the commercial value of a Europe twelve hours away instead of a week. Describe the markets of an Orient a scant one hundred hours away by air, instead of fifty days away by surface transportation. Our whole economy will be quickened by these new forces. There will someday be billions of *ton*-miles developed by air cargo and air cargo alone.

A Bowlus two-place glider trainer.

Technologic Developments

The thinking that has been done here in air cargo has been in view of the results of present-day technology. What future technological developments will permit, what acceleration they will give to the creation of new commerce, to the transfer of cargo to the air, cannot be predicted. The size and performance of many of the planes actually being built and flown today stand as achievements that only a few years ago were believed by many to be unattainable. It is clear that the limits of technologic developments in aviation are not yet in view.

Helicopters and their use in overcoming some of the restrictions imposed by small landing fields are being discussed. Systems for the pickup of cargo with plane in flight are in use and are being developed further. The idea of using parachutes for the delivery of freight under special conditions has been discussed.

In the Cretan campaign, the Germans are said by some reports to have used Junkers JU-52's to tow as many as six gliders. Although great stimulus has been given recently to the subject of gliders in air cargo, additional experience in their construction and use will have to be accumulated before we can measure the full extent of their possible utility and their effect upon cost. Gliders are among the possibilities of the future.

There are advocates for the use of dirigibles in the carriage of cargo. Flying wings seem to be on the way. Despite past failures and many unsolved problems, the advantages of the use of steam for power in propelling aircraft are still being discussed. Warning is given that developments in steam may not yet have reached their final stage. Jet propulsion and rockets are being experimented with. It may be that man will build and empower for the air some object as strange and new to man and to the air as the airplane and dirigible were in the beginning of our lifetime. Mastery of the air has only just begun.

Terminal Facilities

Technologic considerations and the operating costs of the planes to be used in air cargo are the central problems of its development. They are by no means the only ones. Ground handling, pickup and delivery, has often been called the "Achilles heel" of air cargo. Provision will have to be made for air-cargo terminal facilities. The airport problem should not be overlooked. Prior to the war there were only approximately two hundred airports in the United States suited to use by the most modern types of aircraft. At some of them, traffic congestion was in the offing. Additional airway facilities and, as they become available, new types of such facilities will be needed. These are only a few of the collateral problems that must be solved as air cargo grows into its own.

In approaching the solution of these

DIVIDE BY 6 AND

35,000

TAKE the industrial generator shown here (in blue). Divide its weight—280 pounds—by six. Then give it special insulation and other features to permit its operation at 35,000 feet altitude or more. The result is the G-E aircraft generator—light, compact, high-altitude conditioned.

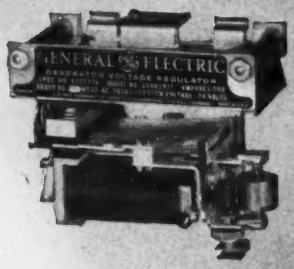
The two generators shown have the same capacity. The larger one is a standard type widely used in industry. The smaller is the aircraft generator used on most of our military planes today. It is built by General Electric, and by others to G-E designs.

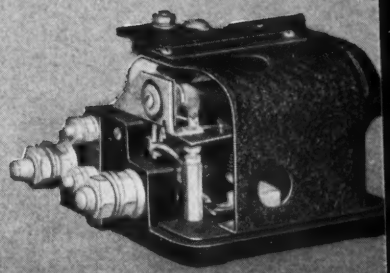
This generator is an example of how electricity, and electrical engineering skill, are helping aircraft designers to increase power and to control weight. Before Pearl Harbor, an aircraft generator then considered light weighed 30 pounds, and had a relatively small capacity. Today, with power demands for individual planes greatly increased, the capacity of the generator has risen substantially, yet weight has increased only a few pounds. This represents a considerable advantage to designers of our military planes.

As ships increase in complexity, the need for automatic operation becomes more pressing—to free air-crew members for more important duties. The resources of General Electric are devoted to the manufacture of such automatic systems. Systems that automatically position cowl flaps and intercooler shutters, synchronize the operation of two or more parts of the ship, control armament—take over flight operations formerly performed by the ship's crew. The flexibility, reliability, and light weight of electric control and operating systems are reasons why many designers now make it electric when they make it automatic. General Electric, Schenectady, New York.

Aircraft electric systems designed and manufactured by General Electric make possible the automatic control of many different flight operations. The degree of secrecy required is so great that we cannot publish information about these integrated systems now. We are glad, however, to discuss the application of automatic electric systems to aircraft with design and production engineers.

GENERAL ELECTRIC





G-E voltage regulators, to maintain correct voltage, and relays to control generator current flow complete the electric generating system. Each of the three units is designed to function with the others as part of a co-ordinated system.

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AIRCRAFT FINISHES

ground problems, points of view must be kept fresh. Landing fields at expensive airports, sometimes far removed from the center of the city, may become outmoded. Landing strips at factory sides may be built and may, to a large extent, take the place of airports in cargo operations. It cannot be predicted now what the new orders of the Air Age will be.

Economic Effects of the War

From what has been said thus far one should be able to begin to see a part of the nature and some of the force of the impact that air transportation and air cargo will make upon our economy and in our international relations after the war.

The war will have advanced the science of aviation by an incalculable number of years. Experiments of such magnitude that they could not have been undertaken in peacetime by private capital will have pointed the way to new achievements in air transportation and air cargo. Industries and persons not previously familiar with the uses and advantages of air cargo will have been introduced to those advantages and, under the pressure of a war economy, will have formed new shipping habits. Planes will become available to meet a rapidly growing demand for the transportation of cargo by air. There will be losses of traffic by other transportation, but there will be more than compensating replacements because of the stimulus that air cargo will give to the national and world economy.

Air-cargo operators will be faced with the problems of the capital cost and the organization of an expansion dictated by demand and accelerated by the rapidly developing possibilities of air cargo and air transportation.

The nation will be faced with the problem of the feasibility of converting to air transportation and air cargo uses the aircraft that, after the war, will not be needed for active military purposes. The use to be made of an aircraft industry expanded to build a hundred thousand and more planes a year will also become a national problem. Private flying will tend to absorb some of this production capacity. The economic growth of air transportation and air cargo may not be able to absorb all this production capacity, but the development of air commerce will draw upon this expanded aircraft industry in which billions of dollars have been invested. Experience already gained in this war has taught that aircraft production capacity must be kept in reserve for some possible other time of national need.

A new accent will be placed upon the national defense value of an expanded commercial air-transportation system. The requirements of our national security may have to be measured in terms of aircraft, airports, airways, and production capacity, and the advisability of subsidizing in civil air transportation facilities an aircraft reserve for national defense purposes may have to be seriously considered.

The new Lockheed Constellation. While speed and other details are restricted, it is said to be capable of crossing the continent nonstop in less than nine hours, carrying 55 passengers. The Constellation is powered by four 2,000-hp. Wright engines, and its cruising speed at half power is claimed to be approximately 100 m.p.h. faster than standard air-cargo or airline ships. The air-conditioned cabin is pressurized to maintain an air density corresponding to 8,000 ft. altitude while the plane speeds along at 20,000 to 35,000 ft. "above the weather."

Pilots, aircraft mechanics, and technical and other personnel for aircraft operation are being trained by the Army, the Navy, and the Civil Aeronautics Administration in the hundreds of thousands. At the close of the war, they will be returned to civilian life—many of them to the opportunities and demands of a rapidly expanding air-transportation system in both the domestic and international fields. Their very availability and their changed manner of thinking will set new courses in the attitude toward air transportation for peace and war.

In the other adjustments in employment caused by the return to a peacetime economy, opportunities will also be afforded in the construction and maintenance of airports, landing strips, terminal and airway facilities, and all the other necessities foreseen and yet to be discovered for making this nation the greatest in the world in the air.

The Freedom of the Air

This is the Air Age. The world is now at war. The nations of the earth are spending their genius and their every resource to hurl from the air a death and a destruction of a magnitude unknown before in history. Peace will bring to the now warring world an opportunity to spend its genius and its every resource in the development of a unity without which there can never be enduring peace.

This nation at peace, having within its own borders the distances that enhance the value of air transportation, the greatest industrial power on earth, may look forward to the swift expansion of its domestic air-transportation system and to an unparalleled extension of its commerce around the world. Coastal or inland, any city in this nation and the world may become an international port of call, only hours away from the rest of the world. As the world grows smaller, national and world unity, cultural understanding, economic wealth, and political peace will be within man's grasp.

It is for America and the world to take air transportation, this new factor in human relationships, this new facility for commerce, this new instrument in national and international policy, and make of the Air Age the Golden Age of a World United. In this thrust at the sky, the destiny of the nation and the world are at stake. Let the history of the Air Age record that its founders had the vision and the power to use for the good of all this new symbol of man's genius.

Designing Aircraft Jigs and Fixtures for Arc Welding to Eliminate Machining*

HARRY V. WENGER, JR.
Boeing Aircraft Company

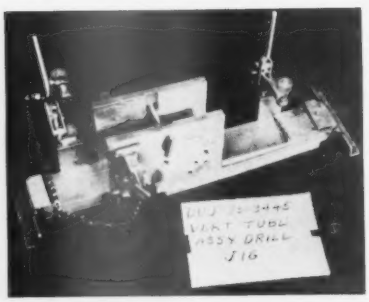
Introduction

Arc welding is no longer a new tool and its use as a method of joining metals is commonplace. This paper, however, deals with the successful employment of arc welding to eliminate expensive machining operations.

The growth of airplane manufacture into a major industry has paralleled the development of arc welding, and it is natural that the airplane industry should accept arcwelding as the means of fabricating the tools that are required to assemble the airplane. Unfortunately, the airplane industry has not been able satisfactorily to adapt arc welding to the fabrication of the airplane itself but this may yet be in the offing. With the advent of large war orders the tooling problem in the airplane industry has become one of major importance.

Nature of Aircraft Tooling

Tooling in the aircraft industry is a unique problem in that the airplane is designed with weight and strength as the primary objectives which take precedence over all other design factors. The result is a structure comprised of thousands of individual parts and thousands upon thousands of bolts and rivets. Naturally, the airplane is divided into many subassemblies and, in turn, this means many jigs or fixtures for each individual part must be located in some manner so that it may be drilled and riveted to make up the assembly unit. Some of the jigs require considerable floor space and two or three flights of scaffolding, while others are for use on a workbench.



Welded subassembly jig.

The tooling problem is complicated by the fact that the design of the airplane is usually going on simultaneously with the building of the tools and templates. This involves last-minute changes that must be incorporated in the tools that are under construction or even completed. The problem, of course, is time. After the drawings of the airplane are available there are only a few months in which to do what would ordinarily be a year's work.

The bottleneck in this accelerated program is always the machining of jig structure and fittings. The fabricating of the rough structure is rapid and can quickly overload the machining facilities and all of the machining facilities available in "outside" shops. It is impossible to plan the work, especially when everything is "rush," so that the rough structure fabricators, the machine shop and the setup men do not have to wait on one another.

Thus, the designing of tools so as to eliminate machining offers major savings in time and money to our aircraft industry.

Previous Aircraft Tooling Practices

The evolution of tooling in the Boeing Aircraft Company is typical of the experiences of any of the larger firms in this industry. Originally, the tools, as well as the airplane itself, were composed largely of wood. Later, the airplanes progressed to welded tube covered by fabric, but the orders, being small, did not warrant a change from wooden jigs and fixtures. This condition existed until the orders for airplanes were for a quantity that warranted serious tooling. Wooden jigs had long been unsatisfactory because of changes in dimension from aging and drying.

The first steel jigs were built up of used pipe or structural steel and arc welding was used for fabricating all of the rough structure. Likewise, many of the fittings were made up of bar sections welded together. The further possibilities of arcwelding were left uninvestigated.

Nearly all aircraft jigs consisted of a framework and fittings that were set on the frame structure. The framework followed a rather definite pattern and generally consisted of a structure of used pipe or structural steel sections welded together. To this structure were attached pads or pieces of steel plate which would later be machined to a common level. After the structure, which sometimes required the largest of planers, was machined, a layout was made on the machined surface, which also served as the base plane of the jig.

The fittings that held the individual parts of the airplane assembly in their proper position were made by welding mild steel bar sections together, after which the fitting was normalized and machined. Machining usually consisted of milling the base and then milling a recess for nesting the airplane part at a determined height above the base. The tolerances were of the nature of ±0.010 in., which meant medium-class work by skilled machine operators. Each fitting required a new setup on the mill, which took time, and because of rather severe inspection often was returned for rework.

The fittings were located on the frame structure to the layout made on the machined base pads and, after being properly set and checked, a hole was drilled in the base of the fitting and tapped in the base pad of the frame. The hole of the fitting was made slightly oversize for adjustment. The fitting was then rechecked and any adjustment required was made by a tap with a mallet. After the fitting was set it was double doweled with taper pins to secure it.

It is obvious that the machine operations represented a considerable portion of the jig fabrication time and, when the

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* Data and illustrations are from a study submitted to the James F. Lincoln Arc Welding Foundation by the author in its recent $200,000 Industrial Progress Award Program for reports and advances and improvements made by the application of arc welding in design, fabrication, construction and maintenance.

The two-and-one-half-year study, in which 408 awards were made, indicated a possible annual cost saving by arc welding of $1,825,000,000, including 7,000,000 tons of steel valued at $271,000,000 and 153,000,000 man-hours of labor.

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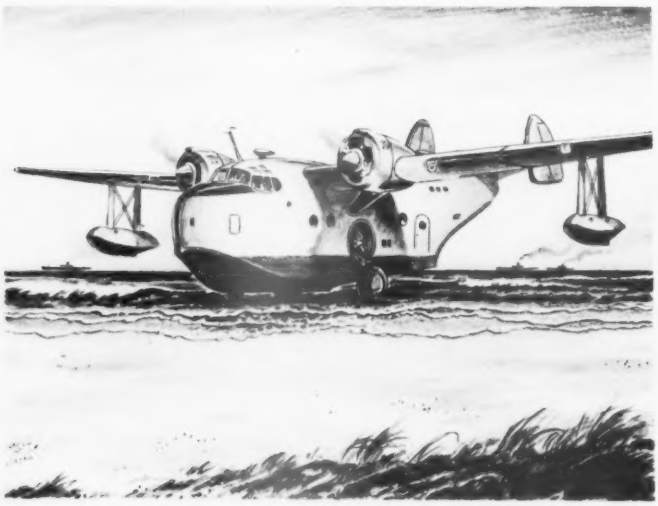


Developments in beaching gear for seaplanes

THE SPECIAL GEAR by which seaplanes are brought up on the land presented several distinctive engineering problems. The volume and weight of the beaching gear had to be carefully correlated so that the gear would float yet would not be too difficult to submerge. B. F. Goodrich engineers developed beaching gear tires that would meet this problem by carrying a load 50 per cent greater than the load carried by landing tires of the same size.

B. F. Goodrich makes available to the aviation industry both dual and single beaching gear tires. They are now in use on seaplanes made by all leading manufacturers.

The Expander Tube Brake also has distinct advantages when operating on beaching gear. This brake system contains no working metal parts to rust in salt water, since the synthetic rubber expander tube is cemented directly to the brake blocks. The expander tube operates by inflating and forcing the brake blocks against the brake drum with uniform pressure around the whole circumference. Applied to beaching gear, this principle provides perfect control of the plane, which is so important to the efficient handling of these giant ships. Unlike other systems, rust is not a problem with expander tube brakes for beaching gear.

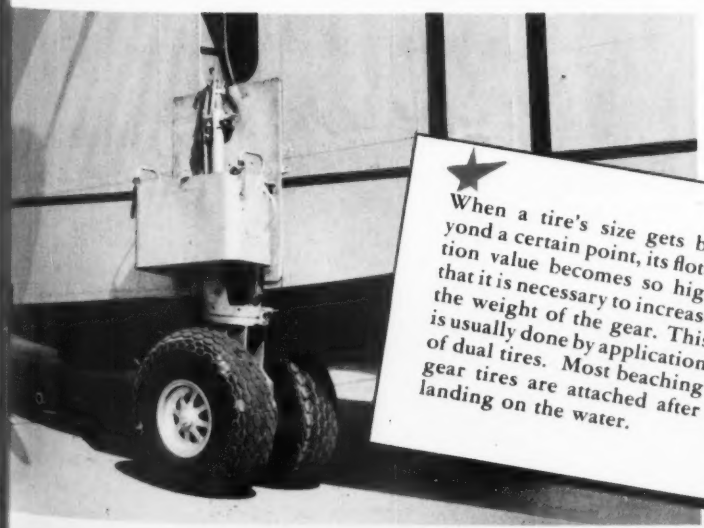
MAKERS OF B. F. GOODRICH TIRES AND OVER 80 RUBBER AND SYNTHETIC RUBBER PRODUCTS FOR AIRPLANES

ARMY (E) NAVY

B. F. GOODRICH BEACHING GEAR TIRES AND BRAKE TUBES OFFER MANY ADVANTAGES

★ *Cementing brake tube directly to brake blocks* eliminates need for metal parts which would corrode in salt water. The tube expands under a full circle of brake lining blocks and forces brake blocks against rim of wheel for smooth braking action.

★ This valve has been developed with a large orifice to permit filling the beaching tire with water when extra weight is required to immerse the tires. Its large-size opening makes it possible to fill the tire quickly and efficiently.



★ When a tire's size gets beyond a certain point, its flotation value becomes so high that it is necessary to increase the weight of the gear. This is usually done by application of dual tires. Most beaching gear tires are attached after landing on the water.

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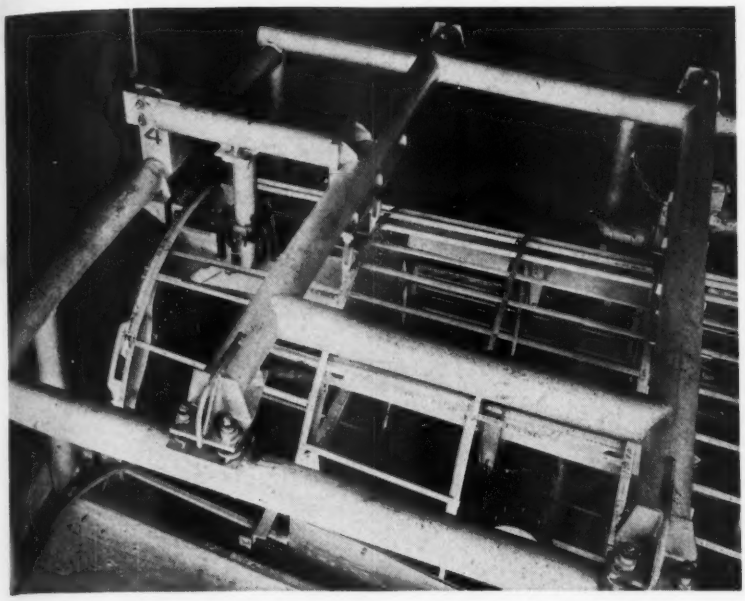
SILVERTOWN AIRPLANE TIRE

PROPELLER FEED SHOE

LIFE VEST WORN BY PILOTS

(*shown inflated*)

B. F. GOODRICH, AERONAUTICAL DIVISION, AKRON, OHIO



Major jig showing application of spherical bushings.

machine shop became overloaded, all work was tied up. The situation was even further complicated by the types of labor involved.

Semiskilled laborers torch-cut the rough structure and prepared it for the welder. They also sawed up the lengths of bar stock that went to make the fittings. This type of work went rapidly because tolerances were large and the work was not held up waiting for other groups to perform certain operations. However, after the base frame came back from machining, the problems were more involved. The layout required a skilled mechanic, as did the work of setting the fittings. These men could proceed, provided all of the fittings were available from the machine shop and no problem came up that required machine work. If all of the fittings were not available, this crew had to transfer to another job, with the result that each crew soon had several jobs under way, none of which could be completed to make room for new jobs coming on.

New Jig Design Procedure

During the last year the orders for military aircraft have called for production schedules that are appalling to an industry where forty planes to be delivered over a period of a year was previously an order. It was obvious that if the tooling department was to meet its schedules a departure must be made from the former jig fabricating practices.

The old jig fabrication procedures, described earlier, were not the result of planned development. Likewise, the development of a new design procedure could not well be the inspiration of one man or the product of one company. Rather, it was a result of a study of the best features developed in our own shops and incorporating the best features of tools developed by other aircraft manufacturers. Formerly, jig design drawings were incomplete and many of the details were left up to the fabrication shops. With this free reign they developed many novel ideas. Because of the lightning growth of the company there is a natural shortage of skilled workers and the shops now require complete working drawings.

In developing a new design procedure there were three objectives: (1) minimize machining, (2) minimize tools required for jig fabrication, and (3) minimize time required for jig fabrication.

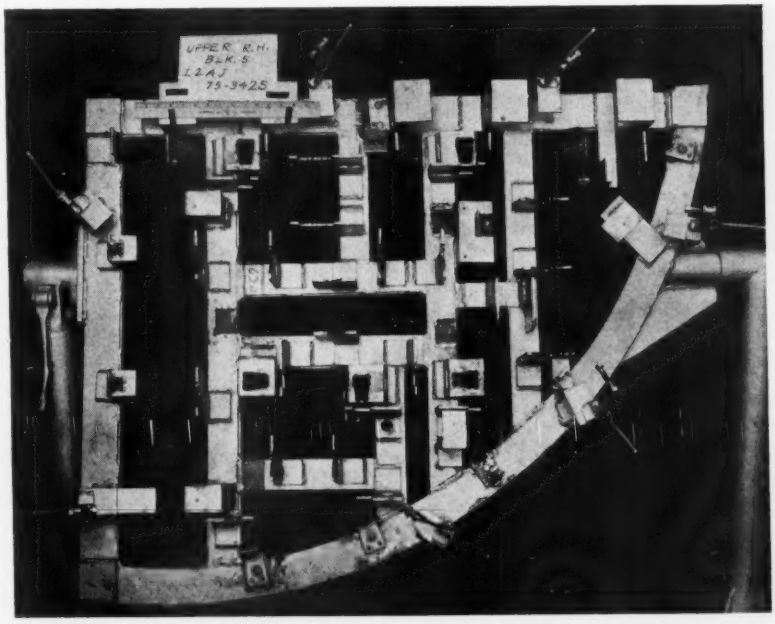
The reason for minimizing machining has been completely covered. It should be brought out that welded jigs made without machining are common and are pictured frequently in welding literature. These jigs, however, are for comparatively rough structures with tolerances of the nature of $\pm 1/8$ in. The problem was to make tools with a tolerance of ± 0.010 in., which comes in the range of medium machining tolerances. This was accomplished by a planned use of arc welding.

Minimizing the tools required for jig fabrication was so successful that the only tools required by the Jig Shop were welding machines, surface plates, surface disc grinders, metal cutting band saws and drill presses. This is in contrast to a complete machine shop, including a 20-ft. planer formerly required.

Minimizing time required for jig fabrication had two motives. The first was to cut down the floor space required in the Jig Shop, and the second was to get jigs out of the shop before changes came through due to minor airplane redesign. It was found cheaper to rework the jigs after they were set up on the assembly lines than to hold up the tools in the fabrication shop waiting for the change information to come through.

Major Jig Design

The large jigs have always been easier to fabricate than the minor jigs,



Typical welded bulkhead structure assembly jig.

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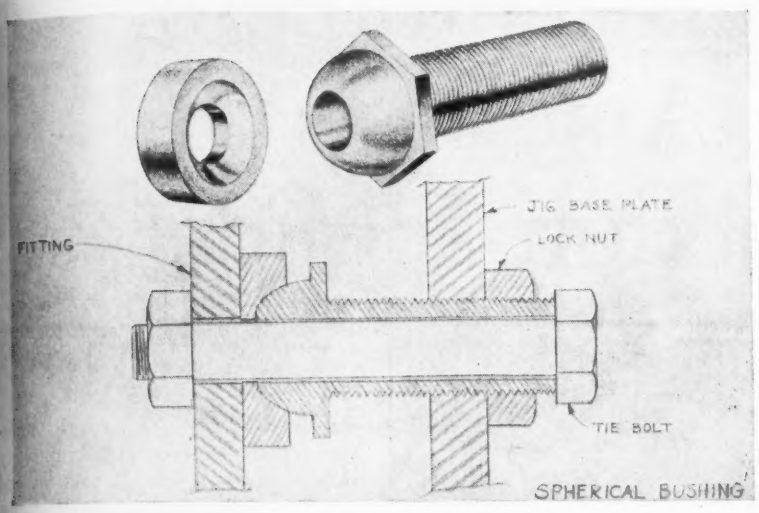

FIG. 1.

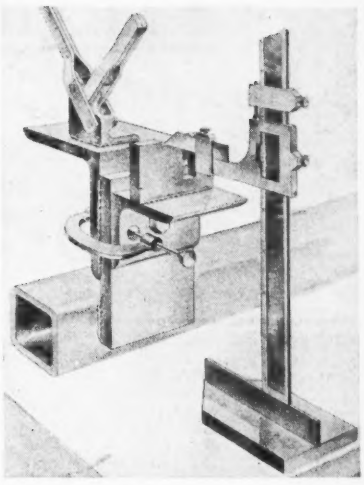

FIG. 2.

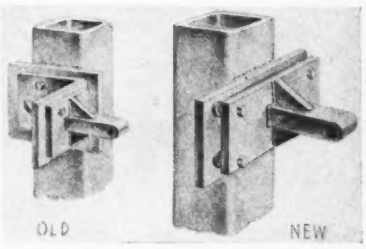

FIG. 3.

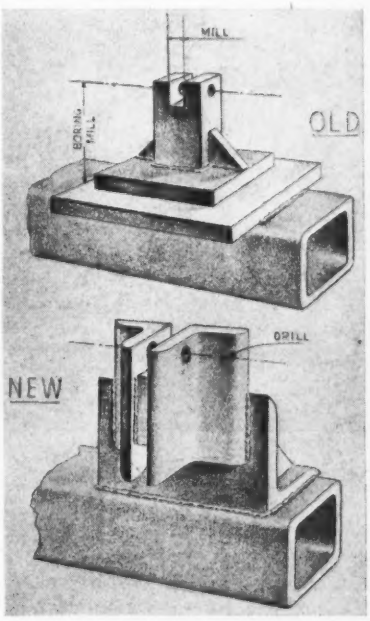

FIG. 4.

mainly because they are rough structure and scaffolding and have relatively few fittings. However, there was often a complicated machining problem with the former method of fabrication. The terminals were mounted on machined pads and, frequently, the pads were attached to a sizeable structure that was difficult to set up even on a large planer. A spherical bushing developed by the shop solved this problem and has become a universal fixture in all of our designs.

The application of the spherical bushing is shown in Fig. 1. The setup consists of a hollow bolt with a spherical head. This sits in a cup with a spherical recess. A plate, or pad, is welded to the jig structure and is drilled and tapped for the hollow spherical bolt. The fitting is then drilled for the tie bolt that goes through the spherical bolt and the cup is put in place. The fitting is set to position by adjusting the hollow spherical bolt in or out of the pad. When properly set, the cup is tack-welded to the fitting and the hollow spherical bolt is locked by a tack weld on the thread where it enters the base pad.

This same fitting is used wherever part of the jig structure must be removed to allow the completed assembly to be removed from the jig. After the jig has been emptied, the section may be put back in place and its proper location is insured by the matching of the spherical surfaces.

A third use for this fitting is as a leveling lug. Aircraft jigs are usually set up using a surveyor's level to establish the reference planes. To do this the jig structure must incorporate a leveling device that consists of this spherical bushing set up at each leg of the jig structure. The use of this spherical bushing permits the pads to be welded to the frame structure, the oversize hole in the hollow spherical bolt allowing for any misalignment of the surface of the pad. By merely applying this one simple device, the necessity for machining was eliminated from all major jigs.

MINOR JIG DESIGN

The problem of eliminating machining in minor jigs is more complicated than for major jigs because the minor jigs have to hold each part that goes to make up the assembly.

The solution to the problem of minimizing machining was one of providing adjustment in every fitting so that it could be set on a frame structure that was out of plane. The second problem, which did not prove to be so serious as feared, was to weld on the structure without experiencing excessive distortion in the frame or fittings.

The following fabrication procedure was developed: The frames are made of low-carbon mild steel structural or tubular sections and, if complicated, are normalized. A general purpose rod, like Fleetweld No. 7, is used. The fittings are cut from cold-rolled steel bar. True cold-rolled steel will distort more upon welding than mild steel, but the smooth surface of cold-rolled steel offsets this disadvantage. No effort is made to weld firmly the fittings to the frames, but instead they are held by short tack welds, one being allowed to cool before another tack weld is made.

The frame structure, after being welded and, if necessary, normalized, is set up on a large surface plate and leveled. Centerlines are scribed on the frame surface, and the layout is transferred from a lofted template that is available for each assembly. The detail drawings of the fittings each carry a reference line that is the plane of the jig, and an arbitrary distance is given to the surface plate. The fittings are clamped roughly in place and then located accurately by a height gauge as shown in Fig. 2. After the fitting is correctly set, the welder

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is called to tack-weld the fitting in place and the clamp is removed. The surface plates are so arranged that one welder can serve four to six setup crews.

A typical nesting fitting is shown in Fig. 3. Here both the old method and the new method are illustrated. The fittings are similar except that arc welding has been substituted for both the bolt and the two dowels.

Fig. 4 shows the old and the new construction of a hinge fitting. The old fitting required: first, the milling of the base; second, the milling of the slot; and, finally, the boring of the hole at a specified distance above the machined base. The welded fitting, on the other hand, consisted of two angles that were clamped together and line drilled. A spacer of the required thickness was welded between the angles to establish the slot, and adjustment was obtained by mounting the fitting on an angle attached to the base frame.

Fig. 5 shows the old and the new way of mounting a terminal fitting using the spherical bushings described above in the section of major jigs.

Conclusions and Costs

The jigs made with the new procedure successfully cut down the assembly time, provide more accessibility, and are easier to rework then the jigs formerly designed.

The monetary saving realized by designing to eliminate machining is further proof of the desirability of this new system of jig construction.

A cost comparison based on a typical bulkhead assembly jig is given below:

	Old Construction		*New Construction*	
Frame Work				
Torch cutting	8 hr.	$ 24	8 hr.	$ 24
Welding	2 hr.	6	2 hr.	6
Normalizing		30		30
Machining	20 hr.	60		..
Fittings—Approx. 50 Are Required				
Cutting	25 hr.	75	25 hr.	75
Welding	5 hr.	15	*1 hr.	3
Machining	60 hr.	180		..
Setting Fittings				
Layout	2 hr.	6	2 hr.	6
Setting fittings	75 hr.	225	100 hr.	300
Doweling fittings	15 hr.	45		..
Tack welding fittings		..	4 hr.	12
Misc. machining	10 hr.	30		..
Totals		$696		$456

* Fittings assembled on setting.
$696 less $456 equals $240.
Percentage of saving—34.5 per cent.

The savings are more pronounced on the complicated jigs such as the typical bulkhead jig. However, the tool fabricating time on a four-engined airplane will run as high as 500,000 hours, and a conservative average saving of 10 per cent will total nearly $150,000 for a contract.

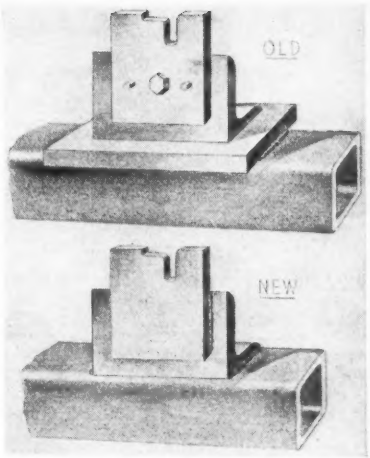

Fig. 5.

The advantages gained from this new jig fabrication procedure are even more pronounced in these days of National Emergency. Savings in the cost of aircraft means savings to the taxpayer but, more important now than monetary savings, is the saving of that priceless commodity called "time."

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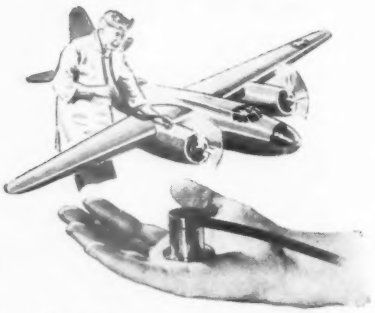
IRONING OUT THE JITTER-BUGS IN BOMBERS!

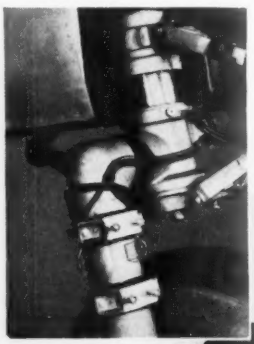
Martin Research in Vibration and "Flutter" has interesting possibilities in many industrial fields



No larger than a silver dollar, the "electric ear" that picks up vibrations.

FLUTTER, bane of aircraft builders and constant threat to test pilots, need no longer be the subject of "trial and error" research, as a result of findings recently announced by The Glenn L. Martin Company. Moreover, in seeking the origin of this deadly vibration which caused planes to shake apart in mid-air, Martin's unique Vibration Department has achieved results of unusual interest to all industry.

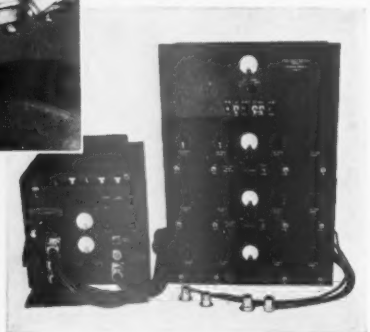
Interesting methods and weapons have been developed for this six-year war against vibration. First, was the development of an electric vibrator to set up artificial vibrations in plane parts and structures, simulating actual flying conditions. Coupled with this are the accelerometer and an oscillograph, used to detect and graphically record the vibrations under study. Both of these devices and use-techniques were products of the Martin Vibration Department. Martin research men are now able, by plotting a graph, to determine the air speed at which vibrations in various plane parts will harmonize to cause flutter and structural breakdown. If this critical speed is well above the design dive-speed of the plane, there is no danger of flutter. The same devices also provide a powerful weapon against another enemy of extreme speed in planes—compressibility. Now available to other aircraft companies, this Martin equipment along with Martin graphs and formulas, makes it possible to determine the flutter characteristics of new models during flight tests. Thus lives and costly equipment are no longer endangered by flutter, while U. S. Bombardiers are assured of steadier platforms and greater accuracy on bombing missions.



In Action on nose landing wheel, equipment records landing shocks, in much the same way that vibrations are detected and recorded.

☆

Accelerometer, below amplifies vibrations picked up by little "electric ears" (in foreground). At left is oscillograph which records findings.



New Horizons For All Industry

In addition to aiding the fight against flutter, Martin equipment is being used to determine dynamic shock and to help overcome motor vibration. This latter field holds far-reaching promise for all industry in the postwar years. Automobiles, trucks, busses, steamships, trains . . . all may be made lighter, more comfortable, smoother-riding. Buildings, housing heavy machinery, will be able to minimize rumblings, vibrations. Delicate mechanisms such as radio equipment will be better mounted for better performance.

Arch-enemy of both structural vibration and resultant human fatigue, Martin vibration research promises to play an important role in building the world of tomorrow.

If the minimizing of vibration will improve your postwar product or plant, tear out this page for your future plans file.

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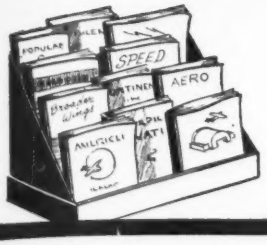

Periodicals

Accessories

The Design of Crossflow Heat Exchangers. Paul A. Scherer. A simple and rapid method is described which has been devised to determine the performance of cross-flow intercoolers, air coolers, or radiators from laboratory tests of a model or basic unit of the cooler. It is said that because of the rapidity with which calculations can be made by this method it becomes easy to determine the relations between lengths, cooling airflow, and pressure drops for a desired performance. Laboratory test data are presented with curves for heat transfer. The solution of a particular problem is worked out and the method of solution is explained, using a supercharger intercooler as the example. It is stated that the same technique applies to any heat-transfer unit in cross flow. The 16 steps in the solution are outlined at considerable length. For illustrative purposes a numerical example problem is set forth, and attention is directed to other design considerations that should be carefully watched. Information is given on ways of obtaining performance data from the laboratory test data through the use of the charts. *Aero Digest*, January, 1943, pages 138, 140, 144, 146, 251, 252, 254, 3 illus.

Hydraulic Remote Control. Data are presented on the Rubery Owen Messier Company's new hydraulic equipment for remote control with temperature compensation, designated as Type C. Developed mainly for throttle and propeller control, this equipment can be applied for any purpose requiring a manually originated movement at a distant point. One of its chief features is the special provision for the complete eliminating of any effects due to temperature variations. The Messier Type C equipment consists of three main components: a lever-operated transmitter, a receiver, and the temperature compensator. *Flight*, December 24, 1942, page 695, 3 illus.

Ceramic Insulated Plugs for Aircraft. The Lodge Sintox-insulated spark plug is described in detail. An important feature of this plug is the employment of the Sintox insulating material, which is a ceramic composition of the sintered aluminum oxide class. In addition to possessing superior mechanical strength, high heat conductivity, and the ability to maintain its electrical insulating properties at high temperatures, this material is said to overcome the problem of rapid lead deposit formation caused by high-octane fuels.

The Lodge plug consists essentially of three parts: (a) central intox insulator enclosing the electrode and sparking point; (b) combined steel screen and gland nut; (c) the steel body that screws into the cylinder and is made gas tight by means of a copper washer. Topics that are particularized in the description of its manufacture are: making the insulator blanks, furnace treatment, insulator assembly, inspection, welding the platinum points, laboratory checks, and rating test. *Commercial Aviation*, January, 1943, pages 66, 68, 70, 2 illus.

Die Sturzflugbremse des Sturzkampfflugzeuges Ju 87 (The Aerodynamic Brakes of the Dive Bomber Ju 87). A detailed description is presented, with photographs and a sketch of the operation of the aerodynamic brakes of the German dive bomber Ju 87. *Schweizer Aero-Revue Suisse*, September, 1942, pages 371, 372, 3 illus.

Design Considerations of Aircraft Electrical Systems. Major T. B. Holliday. Systems of accessories used in aircraft are classified according to the service performed for the increase or improvement of efficiency, safety, ease of handling and comfort. Examples are given such as the controllable-pitch propeller, the retractable landing gear, the automatic pilot, deicing equipment, pressurized cabins, and others. Means of operating such accessories are also classified into mechanical, hydraulic, pneumatic, and electrical groups, each of which is briefly described. Generators are discussed at considerable length, along with bat-

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teries and wiring systems. *Aero Digest*, January, 1943, pages 205, 206, 208, 210, 8 illus.

Fine Furniture Maker Finds Place in Aviation Industry. A Canadian company's transition from furniture manufacturer to airplane accessories producer is related. Details are presented on the adjustment of old woodworking methods to new products. These products include: airplane seats, bomb doors, chain guards, navigators' and wireless operators' desks, fairings, code book and map cases, and three types of parachute stowages. Mention is made of woods, glues, machines, tools, and equipment used. *Canadian Aviation*, January, 1943, pages 72–75, 9 illus.

Aerodynamics

Three-Dimensional Wing Flutter Analysis. Alexander H. Flax. A set of equations is derived for the flutter of a wing-aileron system in three dimensions using methods familiar to the average engineer. The aerodynamic force coefficients are obtained by strip integration of two-dimensional coefficients. The results are presented in a form suitable for direct calculation by assuming that the fundamental vibration modes of the wing in bending and torsion may be used to represent the corresponding displacements of the wing in the flutter motion. The validity of the assumption made is discussed.

Empirical weighting methods commonly used in two-dimensional analyses to account for three-dimensional effects are considered in the light of the results obtained in the paper. Approximate equations are given for the correction of coupled frequencies obtained in still air vibration tests to the "uncoupled" frequencies desired for flutter analysis. The corrections for the effects of the apparent inertia of the air are also included. *Journal of the Aeronautical Sciences*, February, 1943, pages 41–47, 1 illus.

Rate of Climb Calculations. G. Otten. A method is described by which the climbing speed of an airplane can be determined with great accuracy without materially increasing the amount of work involved in the rate-of-climb calculation.

The procedure is outlined in eleven steps, and it is concluded that if the curve of lift coefficient and drag coefficient is drawn accurately the method given is more precise than others. The way in which the acceleration is taken into account is only a more exact repetition of the work already done in determining the rate of climb in a first approximation, which is said to be more accurate than that followed in most of the usual methods. *Journal of the Aeronautical Sciences*, February, 1943, pages 48–50, 3 illus.

Induced Drag of a Twisted Wing. H. W. Sibert. In this paper a formula is derived for the induced-drag coefficient of a twisted wing having a deflected flap. With a slight change in notation, this formula may also be applied to a twisted wing having washout (or washin) at the tips. *Journal of the Aeronautical Sciences*, February, 1943, pages 71, 72.

How to Fair Lines by Graphical Calculus. Dean Madsen. A method is offered as an adaptation of calculus to the problem of fairing, which eliminates lengthy calculations and complicated formulas. It is presented as a simple graphic method of obtaining a perfectly faired and defined double-curved surface, any point of which is available to an accuracy of 0.001 in. After summing up the advantages as simple and easy mechanical steps requiring no knowledge of calculus, a detailed explanation of the graphic calculus method is presented. The three fundamental steps are explained with the aid of drawings, these being the laying down of the original curve, obtaining the first derivative, and integration of the first derivative curve. This gives the faired line and determines offsets for certain integer stations. Part II of the article will contain an analysis of the method for determining offsets for noninteger stations. *Aviation*, January, 1943, pages 136, 137, 139, 140, 349, 350, 9 illus.

Compressibility. Roy E. Marquardt and Robert De Vault. This is the sixth of a series of articles by the writers covering aerodynamic principles and problems in semi-technical language. In past articles it was assumed that the air was incompressible. It is explained that, while a majority of aerodynamic problems can be solved satisfactorily on this basis, in some of the most critical problems the compressibility of the air must be taken into consideration. In the first part of the article basic principles are discussed. Consideration is then given to subsonic and supersonic lift and drag. *Western Flying*, January, 1943, pages 64, 66, 68, 70, 72, 11 illus.

Air Cargo

Who Should Carry Air Cargo? John H. Frederick. The writer discusses the question of whether trucking companies, railroads, or other units should be allowed to enter the air-cargo field as competitors of the air lines or whether such operations should be limited to the air lines. Supported by reasons of economy, efficiency, service, and convenience,

he offers the answer that air cargo should be handled by one coordinated organization owned by the air lines, which are also handling mail and passengers. Reviewing their past decisions upon relative matters, he speculates upon what decisive action will be taken by governmental authorities. The attempts and activities of so-called "outsiders" to enter the air-cargo field are also noted. *Aviation*, January, 1943, pages 255, 257, 344–349, 1 illus.

Flying Freight Along the Amazon. Alfredo de los Rios. A survey of Pan American air-route developments in the Amazon area. It is explained how air cargo, supplanting and improving upon old methods of transportation, is helping to industrialize South America. The purpose of the Defense Supplies Corporation and the activities of the United States in discouraging Axis air-line services and encouraging native organizations are remarked. *Skyways*, February, 1943, pages 58–60, 4 illus.

In Canada, Freight Flies. D. B. Wallace. An article reviewing the rapid expansion of air-cargo and passenger routes in the Dominion of Canada. The writer describes the network of air trails Canada's pilots have blazed during the past decade and presents figures on the amount of air freight transported in recent years. *Air Transportation*, January, 1943, pages 7–11, 7 illus.

Air Power

Aeronautics in 1942. The writer reviews the progress of aviation during 1942 with particular reference to advancements in the design and performance of British military aircraft. Attention is directed to British airplanes that have distinguished themselves during the past year, those referred to including the Stirling, Halifax, and Lancaster. Consideration is given not only to what these planes have been doing but to what they may be expected to do in the future. Mention is made of improvements in the Spitfire which include the installation of the Rolls-Royce Merlin 61 engine with two-stage supercharger, which at an altitude of 40,000 ft. provides twice the power furnished by the original Merlin III engine fitted to this fighter. Another type of aircraft referred to is the de Havilland Mosquito twin-engined, long-range light bomber, first mention of which was made in September. Glider developments are discussed and it is noted that at least two troop-carrying types are being built in England. *The Engineer*, January 1, 1943, pages 7–9, 1 illus.

Aerial Strength. John A. Ward.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

The value of air power is demonstrated by an analysis of the United Nations' and Axis' strength with regard to several factors. The comparative sea, land, and air power of Germany, Italy, Japan, Great Britain, Russia, United States, and China are evaluated, as are their production capacities, leadership, strategic positions, supply sources and facilities, and the disposition of their armed forces. The purpose of this, plus a review of the decisive events of the war, is to show that air power is as vital as sea and land power and that without its full exploitation the war cannot be won. The writer concludes the article with the proposition that the United States air arm be put on an equal footing with the Army and Navy . . . . the efforts of all three to be coordinated by a "Department of National Defense." *Aero Digest*, January, 1943, pages 84–86, 126, 257–261, 6 illus.

An Interview with Wendell Wilkie. Howard Rushmore. Some comments from Wendell L. Wilkie on the accelerated aviation programs of those of the United Nations which he visited. *Skyways*, February, 1943, pages 14–17, 15 illus.

Air Power in 1942. Major F. A. de V. Robertson. A review of British air operations during the past year. 1942 is marked as a period of recovery and transition from a defensive strategy to an offensive one. Phases of the war which are particularized include: the escape of the German battleship "Scharnhorst" and "Gneisenau," the fall of Singapore, the Burmese campaign, the second Libyan advance, the El Alamein action, and the sending of supplies to Malta. The article also discusses the tactics and achievements of Fighter Command, Bomber Command, and Coastal Command. *Flight*, December 31, 1942, pages 708–713, 9 illus.

The Vital Balance of Air Power. Attention is drawn to the British insistence on quality and the German preference for quantity in military aircraft production. Germany's preference for quantity is held to lend strong support to the view that the German air command is obliged to plan aircraft production within certain limits that are industrially most feasible. The writer is convinced that the belligerent who finds the best balance between performance and production will win the war. The necessity of avoiding error in the search for this vital balance is emphasized. The remainder of the article deals largely with air staff planning and requirements. *Aeronautics*, January, 1943, pages 33, 34.

Air Power Double-Crosses the Axis. Alexander Kiralfy. An analysis of how the Axis nations are being defeated by applications of air power which they were the first to exploit. The writer's thesis is that had the Axis countries not featured air power in their military and naval operations first it would not have been developed by the United Nations to the extent that it is now boomeranging upon Germany, Italy, and Japan. Bombing of cities, antisubmarine warfare, air cannon, aircraft carriers, and air bases are among the factors discussed. *Skyways*, February, 1943, pages 24–27, 78, 5 illus.

Air Transport

Airports and Air Planning. F. G. Miles. The writer presents views on the future development of air transport. The design of a great central airport of the future is visualized. A drawing of such a combined landplane and marine aircraft base is furnished. Prewar transport figures for ships and railways are presented in conjunction with a study of air-transport expansion possibilities of the future. Consideration is given to the size of aircraft that will be required when nearly all travelers are carried by air. *Aeronautics*, January, 1943, pages 60, 61, 4 illus.

Transportation—in War and Peace! C. R. Smith. The former president of American Airlines reviews the contributions of peacetime air-transport development to the war effort, reports on what the air lines are doing today, and discusses some future trends of air transportation. He notes three phases of the air-lines' wartime program: schools in which work on both civil and military aircraft is accomplished and airways over which flight operation of both civil and military aircraft are conducted.

The writer states that discussion of postwar transportation must be governed by four basic points of thought: (1) Distance is now measured by time and not miles, with the old handicaps and protection of distance greatly diminished; (2) the airplane is the only vehicle of transportation which knows no physical

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boundaries; (3) we can no longer be guided by our old conception of the map because the airplane can follow the course of shortest distance across the globular earth; (4) aerodynamic research and development are very far from being fully exploited. He judges the potential size and transportation capacity of the airplane to be reasonably unlimited. Giving reasons in support of his belief, he selects New York and Chicago as two of America's future great air-transport centers. *Air Force Review*, February, 1943, pages 4, 6, 26, 1 illus.

Progress in Canadian Air Transport. H. J. Symington. The Trans-Canada Air Lines report for 1942 features the expansion of the company and its improvements in organization and facilities. Figures are quoted on the growth of traffic volume during the past year. Maritime developments, maintenance and overhaul duties, and the increased employment of women are noted. Some plans for the future are announced also. *Commercial Aviation*, January, 1943, pages 53, 54, 2 illus.

The Airline Pilot Goes to War. Fred Smith. Praise is accorded the air-line pilot for the part he is taking in the war. It is remarked how these men are performing varied and difficult feats of transport and combat piloting under conditions different from those to which they were accustomed. *Skyways*, February, 1943, pages 40, 41, 2 illus.

Air Transport. Comdr. C. H. Schildhauer. This article on the Naval Air Transport Service tells how it was organized and developed, what its purpose is, and how its duties are carried out. Created to facilitate the transportation of men and materials to points all over the world where they are needed by the U.S. Navy, some of the more specific missions of this Service are listed. They include: transporting personnel for combat, speeding of replacement engines and parts, carrying essential supplies to the fronts, bringing back essential war materials from foreign countries, and evacuating wounded from the battle zones. Three squadrons are active at present, one located at Alameda, Calif., one at Norfolk, Va., and the other at Kansas City, Kan.

The close identification of the Naval Air Transport Service with commercial air lines is shown throughout the article. Experienced air-line executives helped the Navy to organize it; it is said to operate along air-line procedures, with the elimination of certain unnecessary "paper work." The cooperation of the air lines in assisting the Navy on certain routes is commended. *Flying*, February 1943, pages 127, 128, 236, 238, 5 illus.

The new Curtiss A-25 dive bomber. An Army version of the Curtiss SB2C-1 Helldiver, this two-place mid-wing monoplane is powered with a 1,700-hp. Wright Cyclone engine. The plane is equipped with a three-bladed Curtiss electric propeller and retractable landing gear. (*See* "From the Industry.")

Air Transport Auxiliary. The purpose and activities of Canada's Air Transport Auxiliary are described. How the pilots of this organization collect new aircraft from the manufacturers and fly them to their destination is outlined. The pilots also ferry aircraft from squadrons to repair units and return them after overhaul. It is stated that these pilots can handle up to 50 different types of aircraft. *Canadian Air Cadet*, January, 1943, pages 8, 24, 1 illus.

Canadian Pacific Air Lines in 1942. L. B. Unwin. A résumé of the activities of Canadian Pacific Air Lines during the past year. Expansion of services and participation in the war effort are reported. In addition to a review of the company's exploitation of the northern air routes, its connection with military air observer and flight-training schools, engine overhaul bases, and aircraft repair plants is remarked. The article also includes indication of the postwar development expected from Canadian Pacific Air Lines. *Commercial Aviation*, January, 1943, page 56, 3 illus.

Airplane Descriptions

Lockheed P-38 Has Wide Range of Tactical Uses. From recently released information, details are presented on the Lockheed P-38 Lightning twin-engined fighter. Its versatility is marked by the fact that this airplane has been used on the fighting fronts as a low- and high-altitude fighter, a dive bomber, and a photographic plane. Powered by two 1,150-hp. Allison in-line, liquid-cooled, turbosupercharged engines, the P-38 is described as having a ceiling above 40,000 ft. and a top speed exceeding 400 m.p.h. One of its features is an improved version of the Lockheed-Fowler flap, which aids its maneuverability. Maneuverability is increased by counterrotating propellers to offset the effects of torque. Other listed specifications of the Lightning are its wing span, length, height, wing loading, gross weight, and landing speed. *Aviation*, January, 1943, pages 101, 309, 1 illus.

The B-26. William S. Friedman. A graphic story is presented on how the B-26 was developed to meet the need for a twin-engined medium bomber for overseas service. It is explained that events of 1939 revealed the need for a fast bomber of shorter range than the Flying Fortress which would be capable of sinking a battleship. How the B-26 was designed and manufactured by The Glenn L. Martin Company is described. Improvements in design which have since been made are outlined, and the performance of this aircraft at fighting fronts is told. *Popular Science*, March, 1943, pages 70–75, 9 illus.

Plotting Fighter Progress. F. H. M. Lloyd. In this article the writer describes the development of the Hawker Hurricane fighter. The progress in the performance and armament of this aircraft is traced. *Aeronautics*, January, 1943, pages 28–32. 5 illus.

Heavy Bombers. Information on current models of heavy bombers in the American, British, and German services. Specifications are tabulated for the Boeing Flying Fortress, Consolidated Liberator, Avro Lancaster.

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Handley Page Halifax, Short Stirling, Heinkel He 177, and Focke-Wulf FW 200K2. Information includes span, wing area, weight, bomb load, speed, operating height, maximum range, and engines. Comments are made on the armament of these models and the possibilities of converting some of them to cargo carriers. *Automotive and Aviation Industries*, January 15, 1943, page 23, 2 illus.

Axis Aircraft. This is a compendium of technical data on Japanese, German, and Italian airplanes. Culled from captured models, the information depicts the present state of aeronautical development in the Axis countries. Among the Japanese planes surveyed are army fighters, navy deck-landing fighters, Army light bombers and reconnaissance aircraft, navy deck-landing dive bombers, army heavy bombers. Details are also given on navy shore-based heavy bombers, navy deck-landing torpedo bombers, navy flying boats, and aircraft engines. Among the German aircraft, notes are included on the Me 109 F4, FW 190, Me 110, Ju 88 and Ju 288, He 111 and He 177, and the Do 217. In the Italian group are the Re 2001 and Macchi M.C. 202, the S.A.I. 2097, and the P. 108. *Western Flying*, January, 1943, pages 48, 50, 92, 2 illus.

New Facts on Foreign Fighters. A British writer presents notes accompanied by sketches furnishing some less well-known facts about foreign fighter aircraft development. The genesis of certain recent types, including the German Focke-Wulf 190, is shown to reach back to earlier types, some of them of French origin. Other types discussed are the Dewoitine 570, Arsenal 30, Delanne 20, and the Russian I.15C, the I.20, the I.26, and the Yak 2. Their construction, armament, and engines are described briefly. *Aeronautics*, January, 1943, pages 52, 53, 12 illus.

Airports

The Need for International Aerial "Harbours." S. A. Dismore. The writer discusses the progress in airdrome development in the British Isles with particular reference to runways. He visions runways of the future as being of much greater length and built like artificial "rivers" of concrete. These runways would be at least ten miles in length and would join others of the same length to allow for wind directions most likely to be experienced. It is explained that runways of this length would greatly facilitate landing under "blind" conditions and also would take care of a future trend toward increased wing loadings and higher take-off speeds. *The Journal of the Institute of Transport*, October, 1942, pages 525, 529.

Fighting Snow to "Keep 'Em Flying." Hal W. Hunt. A comprehensive survey of recommended practices and equipment for effective, economical, and efficient snow clearance from airports. Emphasis is placed upon the desirability of complete snow removal at all times. Plows to windrow the snow, followed by rotary blowers to spread it without establishing banks, are generally preferred, but it is said that plows alone can be sufficiently effective. Among the equipment described are: one-way plows, V-plows, and combinations with one or two wings to push the snow farther out and shape the banks; rotary and blowing units; and auxiliary machines such as crawler tractors, patrol graders, and carrying scrapers. Several suggestions for quick helps on snow removal are listed separately. The subjects of ice on runways and sanding runways are covered also. *Aviation*, January, 1943, pages 98, 100, 4 illus.

New Exeter Station Result of Lessons Learned to Date. Innovations in airport construction and equipment are features in this description of the Canadian No. 9 Service Flying Training station near Exeter. In addition to details on its physical aspect, the planning of the airport and the selection of its site are reviewed. Notes are included on the station's housing, training, administrative, and recreation facilities. *Canadian Aviation*, January, 1943, pages 51–53, 8 illus.

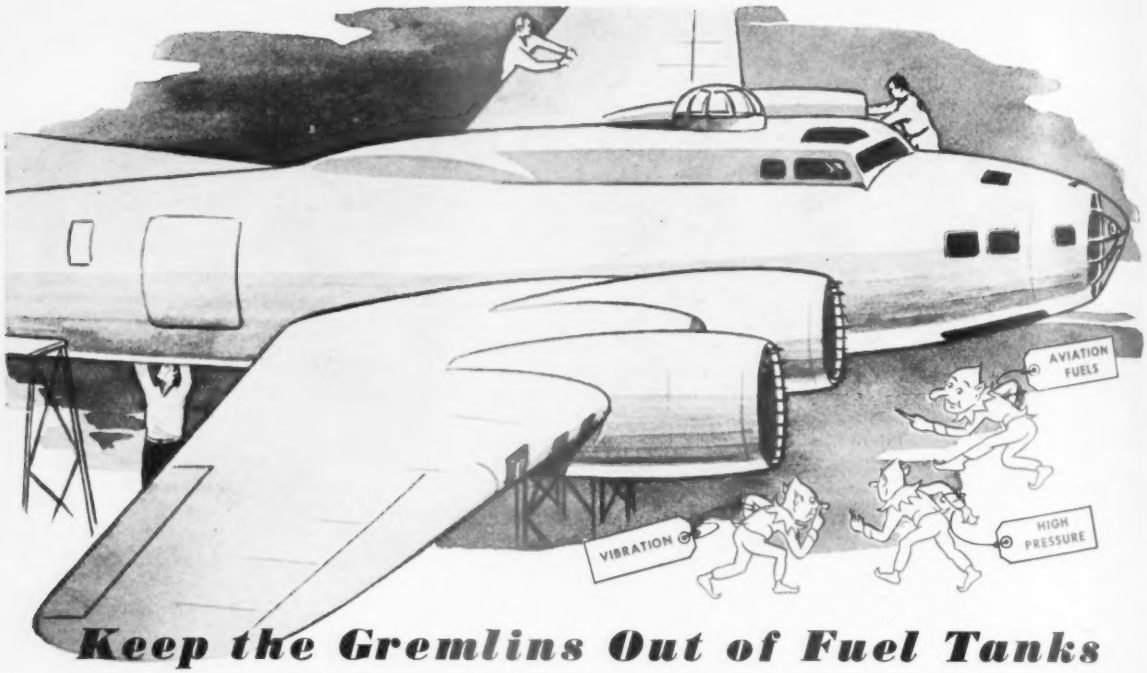
Flight Strip "Hows" and "Whys." Details are given on the site selections, design, and construction of flight strips, as carried out by the Flight Strips Division of the Public Roads Administration in cooperation with the Army Air Forces. Operational need of expected traffic is said to be largely the criterion of design, with consideration of vertical, horizontal, and side clearances, length and width of the runway, and the gauging of shoulders, end zones, and approach areas. Additional problems dealt with are those of topography, drainage, soil, available surfacing materials, and other local conditions. The purpose of single runway strips is designated as twofold: for the present, to afford a means of aircraft dispersal while augmenting active bases; for the future, to provide additional civilian flying facilities, offer auxiliary utilities to transport craft, or afford airfeeder service for small cities and towns. *Aviation*, January, 1943, pages 247, 249, 324, 327, 328, 331, 332, 3 illus.

Armament

Machining Hispano Cannon Components. The manufacture of the Hispano cannon is described in a series of articles of which this is the first installment. It is explained that many British aircraft are equipped with this 20-mm. cannon, which has proved highly successful in combating enemy airplanes provided with modern protective armor. In this installment the writer describes the equipment used for the manufacture of the barrel and outlines production operations. *Aircraft Production*, January, 1943, pages 25–29, 14 illus.

Armament. Comdr. Norman Wyatt Ellis. Offensive and defensive armament of naval aircraft are described in this article which also traces the evolution of the use of armor, guns, bombs, etc., with airplanes. It is shown that sacrificing fire power for speed has not proved feasible and that armament considerations now form the basis of aircraft design. Limited by the amount of information that is revealable, details are included on the following: the bombsight, 0.50-caliber guns, and power-operated turrets. One of the points stressed by the writer is that bombers cannot outfly fighters and therefore they must rely on their armament rather than speed. A brief comparison of the use of armament in German, British, and United States airplanes is given. *Flying*, February, 1943, pages 189–191, 256, 258, 7 illus.

Caracteristicas de las Armas Antiaereas (Characteristics of Anti-Aircraft Guns). José Vierna Belando. A review of conventional antiaircraft guns deals with the wear to which they are subjected, resulting in a short life for the barrel. This is traced to the disturbance of the equilibrium of the molecular structure which causes fatigue of the material. The writer recommends a smaller caliber for antiaircraft guns and an increase of their rate of fire. A gun of smaller caliber is said to be more flexible and easier to handle than present models. He also points out the advantages of using a carriage with three axes: a vertical axis for azimuthal directions, a horizontal axis for zenithal directions, and a third axis that is in a vertical plane, to allow turning the barrel 180°. *Revista de Aeronautica*, August, 1942, pages 94–96, 1 illus.



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Business and Finance

Investment Status of the Aircraft Industry. An analysis of the position of aircraft industry stocks as an investment medium. Although the question of postwar demand for airplanes is conceded to be highly speculative, the deduction is that in view of the basic risks present in any undertaking in moderate amounts common stocks of the sounder aircraft companies may prudently be considered high-quality securities for investment. Two tabulations are included in the article. One lists the 1941 actual earnings per common share of leading aircraft companies, the estimated 1942 earnings and the 10 per cent postwar tax credit. The other gives Barron's comparative stock averages for aircraft companies, air-transport companies, and 50 typical nonaircraft companies on different days in 1941 and 1942. *Aviation*, January, 1943, pages 96, 309, 310.

Civil Aviation

So You Want a Commercial? Norman Warren. From his own experiences in obtaining a commercial pilot's license, the writer describes the commercial test sequence. He points out that, although basically similar to the private pilot's, the test is more difficult to pass because of the emphasis upon precision and technical perfection. The purpose of such requirements is, he concludes, to minimize accidents and create a standard of flying which will aid in waging an effective war. *Air Facts*, February 1, 1943, pages 40–44.

Design

Design Considerations for Long-Range Heavy Cargo Carrying Transport. William Lawrence Lewis. The writer suggests a design for a cargo plane that he claims is capable of fulfilling its purpose to the maximum extent. In great detail he describes the structural characteristics of this plane, its departures from conventional cargo-carrying designs, the apportionment of its interior space for various functional purposes, its engine installations, and the material for its proposed construction. He discusses the solution offered by this design for handling considerations, loading problems, and accessibility of cargo; he indicates its versatility for alternate missions such as troop-carrying, bombing, or a combination of both; and he touches upon its production and cost possibilities. *Aero Digest*, January, 1943, pages 92, 94, 246–248, 250, 251, 1 illus.

Space Limitations and Optimum Conditions in Aircraft Spring Design. Richard Carter. The effect of space limitations on spring performance is analyzed and leads to optimum design formulas for the three most common types of aircraft springs—i.e., tension, compression, and torsion springs. Using the formulas thus derived for a given allowable stress, the relationship between the space limitations, the maximum load obtainable, and the corresponding wire size can be found immediately. In addition, the process of spring design becomes direct and eliminates trial-and-error methods. Scales are reproduced by which, with the use of a straight edge, readings can be obtained for optimum design conditions for different diameters of wire. One such chart is for torsion springs and one is for extension or compression springs. *Journal of the Aeronautical Sciences*, February, 1943, pages 51–57, 1 illus.

Fundamentals of Fighter Design. F. H. M. Lloyd. Design requirements of the small single-seater fighter are examined. In the introduction, reference is made to the trend in fighter design, which is toward high speeds at great heights, and to the present two main types of fighter aircraft. These are the fast, highly maneuverable planes with short range, which is the subject of discussion, and the larger and somewhat slower planes for escort duties. Reference also is made to the need for a low-level attack fighter plane type.

The general requirements of a single-seater fighter are given as high speed, a high ceiling and quick rate of climb, good maneuverability, powerful armament, small size, slow landing speed, and as long a range as practicable. It is shown that the designer must make a compromise when striving to fulfill these requirements.

Considering maneuverability, the writer discusses important qualities required, the time to bank to a given angle, the time to turn, and the radius of turn.

The subject of speed is discussed under sections covering aerodynamic cleanness, aspect ratio, airscrew design, the cooling system, and intake and exhausts. Other sections of the article cover the choice of an airfoil section, airfoil drag, body shape, landing speed, stability control, climb ceiling, and structural problems. *The Journal of the Royal Aeronautical Society*, November, 1942, pages 266–285, 11 illus.

Aircraft Noise. D. C. Greenwood. Preceded by an installment that dealt with the nature of sound and methods of measuring noise levels, the second part of this article examines the causes of noise in aircraft. Advice is given on the solution of the noise problem from two angles: how some aircraft noises can be reduced at their sources and the value of soundproofing the plane.

With propeller and exhaust noises indicted as the worst offenders, the sources discussed are: propeller noise, exhaust noise, engine clatter, aerodynamic noise, and ventilating noise. With regard to soundproofing, two factors are considered: the transmissibility of sound and its absorption. *Flight*, December 10, 1942, pages 631, 632, 1 illus.

Whither Development? R. Worcester. Remarks are made about the development of British warplanes. The writer speculates on the adaptation of new ideas and possibilities of making design improvements. Several lesser-known British planes of older types are mentioned and their evolution into current models is noted. *The Aeroplane*, January 1, 1943, pages 13, 3 illus.

Transport Aircraft. W. Nichols. First part of a discussion concerning the design and essential features of British postwar transport aircraft. This first installment describes two British transport planes whose contemplated production was interrupted by the war, the Fairey FC1 and the Short 14/38. It compares the present cessation of transport aircraft development in Britain with continued development in America, giving some data on the Martin Mars. It then goes on to examine some future problems. Among those touched upon are passenger accommodation and comfort, pressure cabins, supercharging, and layout. *Flight*, December 17, 1942, pages 664–667, 12 illus.

Transport Aircraft. W. Nichols. Second part of an article dealing with the development of air-transport design in postwar Britain. This installment is devoted mainly to a study of probable power plants, assisted take-off, and refueling during flight of long-range types. With their operation explained and their eventual usefulness demonstrated, experiments with composite aircraft are described.

Jet propulsion, turbine-driven propellers, and greater application of plastics are considered as possibilities for further development. Some of the conclusions reached are that: future land transports will have tricycle undercarriages; four-engined postwar

transports will be followed by six-engined aircraft; enclosure of power plants within the wings is probable; long-distance, nonstop flights will be refueled in the air; and composite airplanes will be used, especially for high-speed air-mail traffic. Reiterating the importance of air transport to the survival of the Empire, the writer terminates the article with a proposal for a British postwar air-transport project. *Flight*, December 24, 1942, pages 692–694, 6 illus.

Lofting Problems of Streamline Bodies (Part 9). Carter M. Hartley and Roy A. Liming. Resuming after a lapse of six months, the ninth in this series of articles presents a study of significant graphic techniques related to second-degree curve development. The discussion is focused primarily upon graphic methods, although the relationship of such techniques to the mathematical principles covered in the earlier articles is maintained. The fundamental principles and theorems of projective geometry are treated in such a way as to facilitate the correlation of the techniques to analytic geometry. A simplified set of self-explanatory conventions is employed for describing the graphic procedure in each case. The graphic construction of the general conic is explained by a series of six cases, each of which comprises a problem, its solution and its application. Each case is illustrated by drawings to which the text refers. *Aero Digest*, February, 1943, pages 234, 236, 239, 240, 14 illus.

Some High Spots of 1942. W. Nichols. This is a survey of the technical progress made during the past year in aircraft, engines, airscrews, airplane armament, etc. Although the article mentions American and German developments, it is mainly concerned with British attainments. The point is stressed that the foremost types of British aircraft in their latest versions are superior to any produced by the Axis thus far.

Main features of the following planes are reviewed briefly: Avro Lancaster, Handley Page Halifax, Short Stirling, Westland Whirlwind, de Havilland Mosquito, improved Spitfire with the Merlin 61 engine, Seafire, and Bristol Brisley. Among the American planes the following are noted: Lockheed Lightning, North American Mustang, Douglas Boston III, North American Mitchell B 25 C, Curtiss Warhawk, Republic Thunderbolt, and Lockheed Ventura. The German planes mentioned are: the Focke-Wulf FW 190 and the Dornier DO 217E. Remarks are also made on the German Blohm and Voss BV 222 six-engined flying boat, as well as the British Typhoon fighter with Napier Sabre engine and the York transport type. Engines commented on include: the Merlin XX and 61, the Napier-Halford Sabre sleeve-valve engine, and the German BMW 801A two-row radial. *Flight*, December 31, 1942, pages 717–720, 10 illus.

Engines

Air or Liquid—Which? Charles Kennett. The characteristics of air-cooled and liquid-cooled aircraft engines are compared. Consideration is given to the advantages and disadvantages of both types with particular reference to effects on airplane performance. The writer tells how factors such as reliability, low upkeep, and fuel cost have influenced the course of engine development in the United States and Europe. Marked advances have been made in the design of both air-cooled and liquid-cooled engines. Developments that have resulted in a reduction in the weight of air-cooled engines are described. It is explained that, de-

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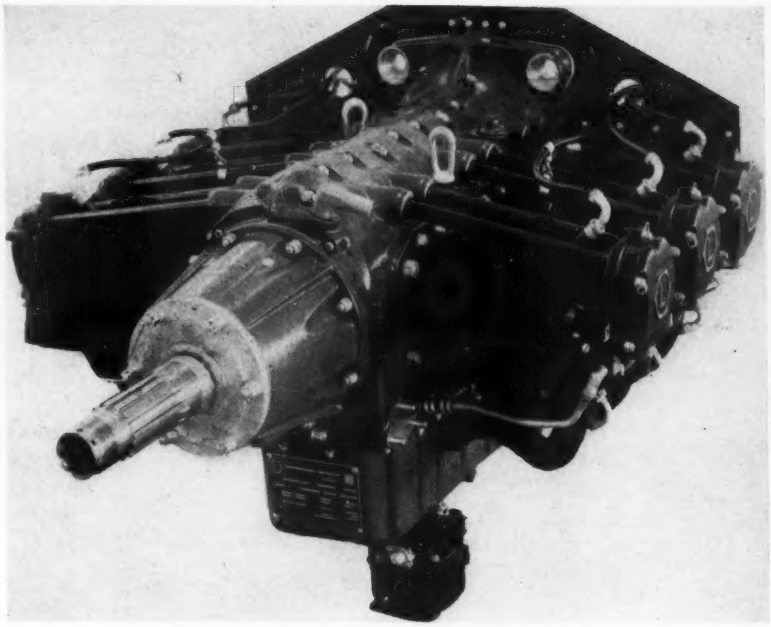
spite the great reduction in drag brought about by improved cowling, the drag of the air-cooled engine is greater when compared to the drag of the liquid-cooled installation. Improvements in the cylinder head design of radial air-cooled engines have resulted in better cooling, and this has made possible greatly increased mean effective pressure in the cylinders. More resistant bearings have brought about higher crankshaft speeds. Because air-cooled engines are more accessible, the maintenance cost is lower than in liquid-cooled engines. It is stated that radial air-cooled engines and liquid-cooled engines of equally good design have about the same weight per horsepower, but when the weight of the radiator of the liquid-cooled type is added the installation as a whole will be heavier. Liquid cooling systems require plumbing work when leaks develop and are vulnerable to enemy bullets. Though liquid-cooled installations weigh more than similar air-cooled units, the former of more than 1,000 hp. can compete with the latter because of lower drag and the lower fuel consumption due to the higher compression ratio that can be used. Information is presented in tabular form on the horsepower and weight of the Pratt & Whitney Hornet, Wright Whirlwind, Rolls Royce Peregrine, and Rolls Royce Merlin X. *Air Life*, March, 1943, pages 32, 33, 50, 6 illus.

Requirements for Carburetor Air Filters for Aircraft Engines. Wayne D. Cannon. Consideration is given to air-filter requirements for the carburetors of aircraft engines. It is stated that the present war, in which airplanes have to be operated in every part of the world, has brought recognition of the need for satisfactory air filters. Various types of filters are discussed with the aid of illustrations, these including a crude desert-made air scoop, a German filter used on the Messerschmitt 109, and various installations designed in the United States. It is noted that the American designs are quite different from those of the British and Germans because of the extensive development work carried out by the automobile and air-conditioning industries. Attention is drawn to the viscous impingment filter, which, it is stated, has been found easy to adapt to aircraft engines and capable of efficient operation. Descriptions of a number of installations using this type of filter are presented. With this filter, it is stated, carbureter metering will not be upset and no added duties will be imposed on the pilot. *S.A.E. Journal* (Transactions), February, 1943, pages 33–37, 63, 11 illus.



The new Lycoming GO-435 six-cylinder horizontally opposed 210-hp. engine using a planetary type reduction gearing. The gear ratios of 77 to 120 provide a propeller speed of 1,925 r.p.m. at the rated crankshaft speed of 3,000 r.p.m. (*See* "From the Industry.")

P.E.R.A. The activities of the Propeller and Engine Repair Auxiliary, a base of British Overseas Airways Corporation, are recounted. In addition to overhauling Bristol engines for the R.A.F., this auxiliary salvages suitable Bristols from crashed aircraft and restores them to airworthy condition. The various divisions of the P.E.R.A. include planning, stores, dismantling and cleaning, inspection, cylinder overhaul and subassembly, and magneto and carburetor shops. Figures are quoted in evidence of the financial savings effected by their salvage plan. *Flight*, December 17, 1942, pages 668, 669, 4 illus.; "Recovery of Crippled Motors," *The Aeroplane*, December 25, 1942, page 733, 2 illus.

Marrying the Engine to the Airframe. Consideration is given to air-cooled radial aircraft-engine installations. Comparisons are made between the layout of the Bristol Hercules power plant and that of the B.M.W. 801a power plant as fitted to the Dornier 217 twin-engined bomber. It is noted that the Bristol power plant, which provides good accessibility to the rear of the engine, reflects the British engineering trend toward the standardization of aircraft power plants. A study is made of the constructional features of the British and German installations. Close inspection indicates that the German power plant is less well planned as a standardized unit but that it has some points of special interest because of its compactness. Reference is made to the work of American engineers in the development of cowling and cooling which has played an important part in the advance of the air-cooled engine. *Aeronautics*, January, 1943, pages 54, 55, 2 illus.

Interchangeable Power Plants for British Bombers. M. W. Bourdon. Bristol Hercules 14-cylinder sleeve-valve engines are now being supplied to British aircraft assembly plants as a complete power plant. It is explained that the policy of supplying complete standardized power units has been developed as a result of collaboration between the British aircraft ministry and aircraft manufacturers and is of particular importance as affecting the Bristol Hercules and Rolls-Royce Merlin engines. Hercules engines in certain twin-engined and four-engined airplanes are interchangeable with the Merlin engine. *Automotive and Aviation Industries*, January 15, 1943, pages 42, 43, 3 illus.

Fighting Horsepower Assured When Spare Parts and Engines are Made Together. Thomas A. Bissell. In this article the writer describes how Pratt & Whitney plans, schedules, and controls its production so that spare parts for each engine are produced simultaneously with its manufacture. With each order for engines, parts are made to keep these engines running for a year. Information is furnished on how the replacement percentage of parts is deter-

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mined for each engine. The writer tells the way parts lists are compiled and discusses the basis of service planning. *Wings*, January, 1943, pages 307–309, 4 illus.

Rolls-Royce Merlin "Sixty-One." G. Geoffrey Smith. Details are presented on the two-stage, two-speed supercharged engine, the Rolls-Royce Merlin "Sixty-One." A development of the twelve-cylinder V-type liquid-cooled Merlin, the new engine's improvements give it a greatly increased power output and a far greater range. In addition to a description of the engine itself, the article includes an explanation of the principles of two-stage, two-speed superchargers. It traces their development and cites their advantages, demonstrating how stratosphere flight is achieved by their use. Characteristics of the Rolls-Royce Merlin "Sixty-One" are tabulated and the subject matter is illustrated by drawings and photographs. *Flight*, December 17, 1942, pages 655–659, 11 illus.

Flight Technique

Cockpit Procedure and Airways Traffic Control. Capt. Fred Smith. The writer describes the duties of the pilot when in airway or control areas. It is explained that to avoid the danger of collision with other planes and to alleviate channel congestion the pilot must be attentive to these duties. The importance of adhering to the selected or assigned altitude while "on instruments" is emphasized. *U.S. Air Services*, January, 1943, pages 15, 16, 1 illus.

Thin Air. Wolfgang Langewiesche. A detailed discussion of the advantages to be gained for the small airplane in high-altitude flying. Explaining the causes and effects, the writer shows why the airplane becomes more efficient at high altitude and goes farther or faster—or both—on less fuel. The proper flight technique is outlined and special consideration is given to ascent and descent. How to make the correct altitude choice for a particular airplane is also advised. *Air Facts*, February 1, 1943, pages 46–64.

Technique to Shorten Takeoffs and Landings. R. deH. Williams. Based upon a mathematical analysis of the key factors, this is a study of how minimum ground runs may be effected with any given airplane. Attention is specifically directed to take-off attitude for minimum roll, ground effect, and landing attitude for minimum roll. Two conclusions are offered. One is that the attitude for minimum take-off distance for a given field or runway surface may be determined from a mathematical equation. On fields rougher than hard turf it is recommended that in most cases the take-off be made tail down. The second conclusion is that minimum landing roll is obtained when the landing is made three point and the roll continued in a tail-high altitude, applying the brakes as much as possible without skidding the tires or overturning the airplane. However, it is cautioned that this type of landing should be regarded as an emergency maneuver only. *Aviation*, January, 1943, pages 94, 95, 313, 315, 316, 319, 5 illus.

Fuels

Vapour Lock. The problems encountered in aircraft fuel systems during rapid ascent are discussed and methods of solving them are indicated. Attention is specifically directed to vapor pressure variations with fuel temperature while the aircraft is climbing. Two ways of preventing the increase of fuel vapor pressure are suggested. One is to increase the air pressure on the surface of the fuel by applying air pressure in the tank. The other is to reduce the fuel temperature to a point where the fuel vapor pressure will always be low enough to prevent boiling or excessive vaporization. *Flight*, December 24, 1942, pages 690, 691, 3 illus.

Gliding and Soaring

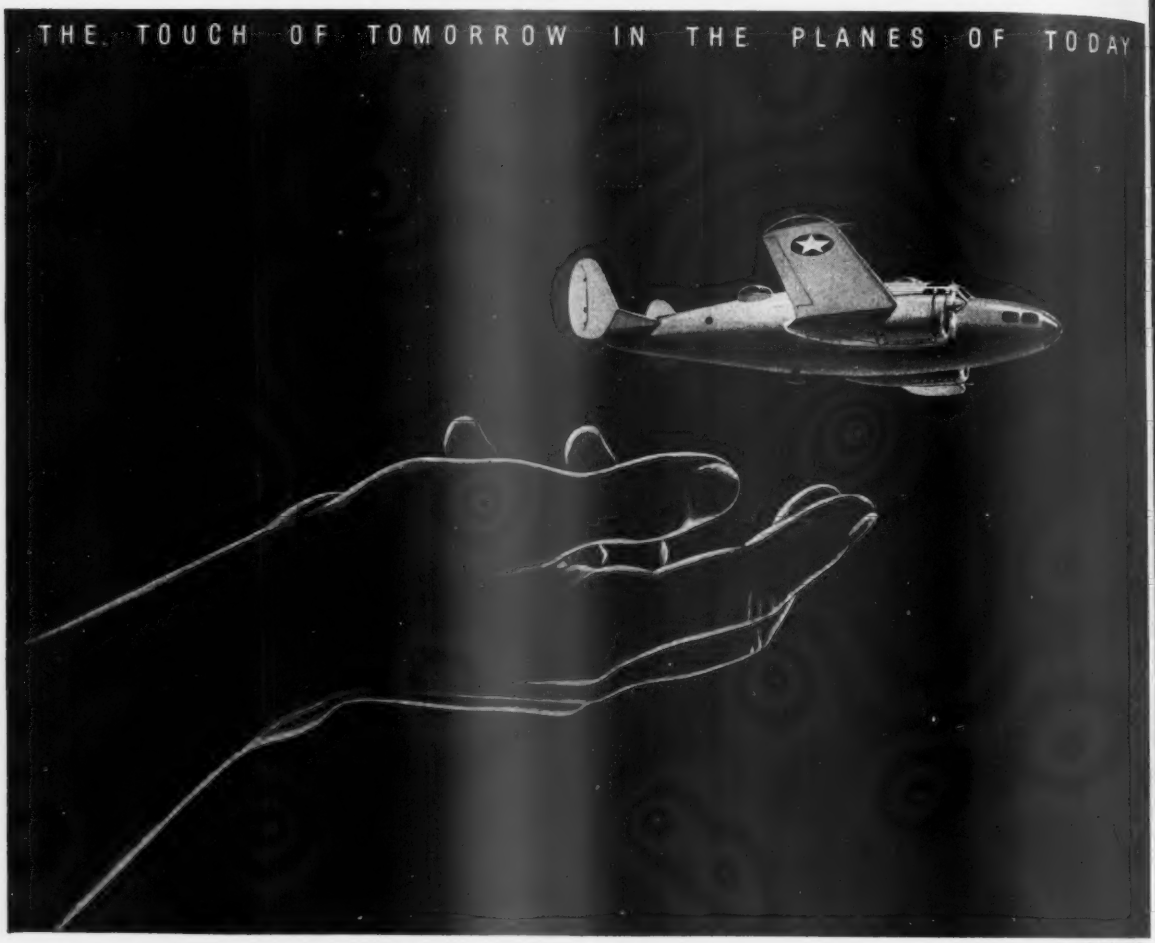
Slope Soaring. August Raspet. After a brief review of the development of soaring technique, an attempt is made to obtain a quantitative rule for determining the vertical velocities of air currents flowing over slopes and ridges. In attacking the problem use is made of the theoretic rule of the two-dimensional flow of a nonviscous incompressible fluid over an extended obstacle such as a ridge, given by Milne-Thomson. Attention is called to limiting factors in the results obtained. Much of the higher mathematics used in the solution of the problem has been avoided in presenting the subject to the reader. Curves are derived showing the vertical velocity distribution over a ridge. It is explained that the maximum height to which a sailplane can rise over a ridge can be obtained from the equation of vertical velocity. Confirmation of this is found in a flight made on December 7, 1941, by Jack Brookhart and a passenger in a Schweizer two-place sailplane. It has been empirically stated that the maximum altitude a sailplane can attain above a ridge by pure slope soaring is approximately three times the height of the hill above the general level of the terrain. The writer uses the results of the analysis to answer the question with mathematical certainty. *Soaring*, September-October, 1942, pages 1–3, 13, 1 illus.

Are Gliders the Answer? A. L. Riggs. The future of the cargo-carrying glider is discussed. The writer tells of the increased amount of freight that could be transported with a medium-sized airplane when towing cargo-carrying gliders and describes how crews could be reduced. He states that with the aid of gliders transportation costs could be cut. *Air Transportation*, January, 1943, pages 19–21, 1 illus.

Gliders. Lt. Col. John Wehle. Describing the purposes for which they are used, the writer defines military gliders but acknowledges their limitations when compared with powered transports. Although he demonstrates the advantages of utilizing military gliders, he cautions that they should only be regarded as an auxiliary air-transport service. Their advantages, he indicates, lie mainly in the fact that they can be built more quickly, cheaper, and of nonstrategic materials; their disadvantages are that their work can be duplicated more efficiently by powered planes and that they cannot fly under instrument conditions. From a review of German glider operations in Belgium, Norway, Libya, and Crete, it is concluded that the use of military gliders falls into the category of "for special purposes only." *Flying*, February, 1943, pages 109, 110, 283, 4 illus.

Training Glider "Sparrow." Waclaw Czerwinski. A description is presented of the training glider Sparrow, designed by a Polish engineer who left his native country because of the war, became an employee of the de Havilland company of Toronto, and organized a glider club for which the Sparrow was built. The specifications of this glider are listed. *Soaring*, September-October, 1942, pages 8, 12, 1 illus.

Gliding Assumes More and More Importance. Glider training activities in the United States and Great Britain are described, and the lack of interest Australia is showing in the subject is deplored. It is stated that because of the lack of official interest in glider training the six Australian clubs may soon cease to exist. The value of gliders for troop transport is stressed, and glider flight technique is outlined. The writer draws a picture of the important part the glider is playing in flight training, aircraft engineering development, and meterologic research. *Aircraft*, November, 1942, pages 10–13, 42, 9 illus.



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(From letter dated November 25, 1942 to Colonel J. C. O'Laughlin)

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High-Altitude Flying

The Sky is NOT the Limit. Major Nathaniel F. Silsbee. This is an article on high-altitude airplanes now used in combat. While bombing types are mentioned, discussion is devoted mainly to German, British, and American high-altitude fighters. Some of the fighters on which data are presented are: several models of the Messerschmitt series, the Focke-Wulf series, the Spitfire, the Lightning, and the Thunderbolt. The article also includes explanations of superchargers and pressurized cabins. Emphasis is placed upon the prediction that airplane design will attain higher and higher ceilings. *Skyways*, February, 1943, pages 28–33, 78, 12 illus.

Oxygen Makes the Flyer. Lt. Fred Tupper, Jr. The purpose and operation of the low-pressure oxygen ground chamber, used in Naval aviation training, are explained. By accurately simulating high-altitude conditions on the ground, this unit affords a means of indoctrinating aviation cadets with the needs for oxygen and shows them how to recognize the effects of low pressure on the human body. It is used also as a basis for assigning students to different types of airplanes, in accordance with their susceptibility to anoxia and aeroembolism. The various symptoms of anoxia and aeroembolism are described. *Aero Digest*, January, 1943, pages 88–90, 256, 8 illus.

Instrument Flying

Instrument Approach and Orientation Procedures in Radio Range Flying. Ewan D. Boyd. This is part V in a series of articles on flying the airways of Canada. In it the basic principles of instrument approach and orientation procedures are outlined. Data are presented on making a range let-down, let-down procedure, missed-approach procedure, bracketing an unknown leg, and bracketing a known leg. Other phases of the subject considered are: orientation on a range, the average bisector, quadrant identification, combination method, a standard method, orientation near the station, and the use of volume control. In addition to a knowledge of these procedures, the need for actual practice in a Link trainer is stressed. The writer also points out the usefulness of range diagrams. *Commercial Aviation*, January, 1943, pages 76, 78, 80, 82, 84, 7 illus.

Instruments

The Three-Component Accelerometer. J. E. Shrader. The writer calls attention to three fields in which the use of an accelerometer is of value, these being automobile, railways, and airplane transportation. It is explained that in each of the three fields accelerations are encountered which may be divided into two groups, one of which covers comparatively low-frequency accelerations largely under the control of the operator and the other high-frequency accelerations resulting from the vibration of parts of the moving body, due to structural flexibility of equipment and to conditions of travel. The design of an accelerometer for each group of accelerations is stated to require special treatment. The paper covers a description of an accelerometer designed more especially for high-frequency accelerations in which instrument special means have been provided for damping. *Journal of The Franklin Institute*, December, 1942, pages 549–566, 9 illus.

Jet Propulsion

Rocket Power for Assisted Takeoff. Roy Healy. The use of assisted take-off for military aircraft with heavy bomb loads is considered with particular reference to the employment of "rocket" power as the motivating agent. Mention is made of the fact that the idea of using auxiliary power for this purpose is not new. Attention is drawn to the reduction in the length of airport runways which can be accomplished when bombers are assisted in the take-off. It is stated that experiments with small jet motors burning liquid fuel have shown sufficient promise to warrant consideration of their use as auxiliary booster motors for aircraft. The design of the simple jet motor is described and the performance of small jet motors that are being successfully used in meteorologic sounding rockets is discussed. It is noted that reports indicate that Germany already is using "rocket" power to aid heavy bombers in their take-off run. The employment of powder rocket charges for present aircraft design is investigated, consideration being given to the thrust and thrust-time factor in the take-off run. *Aviation*, January, 1943, pages 100, 221, 223, 3 illus.

Lighter-Than-Air

Lighter-Than-Air. Capt. T. G. W. Settle. The writer discusses the present uses of lighter-than-air craft by the U.S. Navy, as well as their possibilities for further development. Three types are considered: blimps, barrage balloons, and airships. A review of the blimp's performace characteristics and its war applications credits it with several advantages in the protection of convoys and coastal shipping. However, it is stated that, although blimps have proved of great value in the antisubmarine campaign, they are capable of a far greater contribution to the war effort than they have been permitted to make to date.

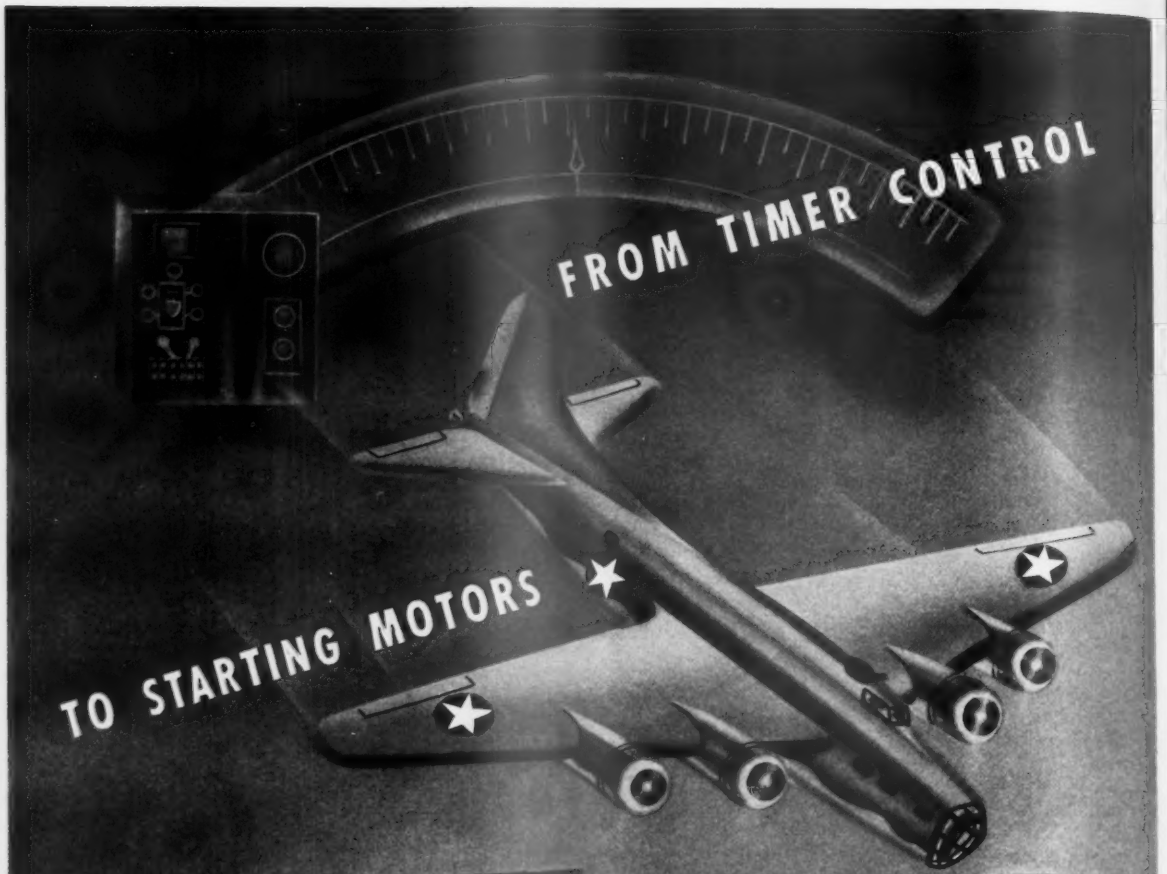
The role of the barrage balloon in keeping attacking airplane formations at high altitudes is explained briefly. With regard to airships, the stage of development of both airship plane carriers and cargo-carrying airships is marked. *Flying*, February, 1943, pages 184, 266, 272, 275, 3 illus.; "Blimp Blasts Undersea Blitz," by R. G. Picinich, Jr., *Skyways*, February, 1943, pages 34–37, 8 illus.

Barrage Balloons. Lt. Col. Bernard L. Smith. This article explains how Marine Corps barrage balloons, supporting steel cables, act as fence-like guards to keep out low-flying enemy aircraft. Two general types of balloons are used by the Marines: one is a completely gas-filled bag depending on the internal rigging for its shape maintenance. The other is a part gas, part air-filled balloon known as the "ballonet type." The maintenance and operational problems of the barrage balloon squadrons are covered. *Flying*, February, 1943, pages 111–113, 298, 299, 5 illus.

Maintenance

Ground Crews. With commendation for their spirit and ability, the work of Naval ground crew members is detailed. Trained to perform their duties on either land or aircraft carriers, these men are graduates of Naval technical schools with aviation ratings as machinists' mate, metalsmith, ordnanceman, or radioman. The radioman is responsible for the operation and maintenance of all radio equipment used by the service, the ordnanceman is concerned with the fire power, armament, and weapons of a plane; the machinists' mate and the metalsmith repair the plane and keep it in perfect condition. The article mentions the fact that ground crew men who are expert at both radio and gunnery are often advanced to flight crews. *Flying*, February, 1943, pages 129, 130, 300, 2 illus.; "Technicians," by Lt. Fred Tupper, Jr., *Flying*, February, 1943, pages 174–177, 254, 256, 9 illus.

Metallizing for Better Maintenance. L. E. Kunkler. The increased number of uses for metal spraying in airplane maintenance and production are examined and described. Worn cylinders, bearings, and engine mounts are among the parts that can



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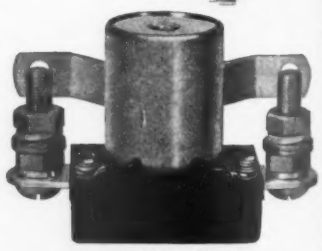

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be reconditioned by this process. As a maintenance technique metallizing also has been used to build up the water-jacket surface on a drop hammer shaft with stainless steel, for spraying zinc on bearing surfaces, and for building up roller-bearing surfaces. As a production technique metallizing has been utilized in tooling and jig departments and in the repair of various types of drop hammers and other forms of forming dies, molds, etc. *Aviation*, January, 1943, pages 231, 233, 235, 342–344, 6 illus.

Will Mfrs. Maintain Airline Equipment? E. J. Foley. The writer considers two possibilities for the disposition of airplane components requiring servicing or overhaul. One is the specialist shop, air-line operated. The other is manufacturers' on-the-spot service and overhaul depots. Discussing the latter method, he explains that the general aircraft structure that may be regarded as not requiring any periodic teardown or overhaul could remain the province of the air-lines maintenance organizations but that the servicing of such components as engines, propellers, and accessories could be subcontracted to their original manufacturers. The use of such subcontracting depots at airports is discussed from various angles. *American Aviation*, January 15, 1943, pages 46, 60, 1 illus.

Air Links with Empire. The maintenance of flying boats at a marine base of the British Overseas Airways Corporation is described. The article deals with the work of the service engineering department where some of the maintenance work on seaplanes is carried out. Problems connected with the supplying of spare parts for the many types of seaplanes and engines which must be serviced are discussed. The maintenance base must also have a large stock of tools and equipment to handle the varied types of aircraft. Details of engineering maintenance are found in sections covering the staggering of overhauls, the overhaul of units, the inspection department, and adapting military machines. *Modern Transport*, November 14, 1942, pages 3, 12, 5 illus.

On Serviceability. Michael Gray. From his own experiences as an airplane fitter, the writer delineates the work of R.A.F. ground crews. Depicting some of the difficult conditions with which the maintenance men are faced, he acclaims their spirit of willingness and cooperation and the high percentage of aircraft serviceability which they achieve. *The Aeroplane*, December 25, 1942, pages 736, 737, 4 illus.

Structural Repair. James E. Thompson and Charles A. Carter. The fourth part of a continued article advising on procedures to be followed in repairing structural parts of the airplane. This installment deals with repairs to flight control systems, cowlings, fairings, and cockpit enclosures. In the cowling and fairing portion of the article, the major part of the discussion is devoted to the replacement of Dzus fasteners and springs. In the cockpit-enclosure portion, the repair of Plexiglas is noted especially. *Western Flying*, January, 1943, pages 51, 52, 54, 56, 6 illus.

Coordination is Key to Mass Maintenance. E. J. Foley. Two basic possible solutions to the problem of air-line production-maintenance are stated to be air-line specialist shops and manufacturers' maintenance establishments. In this article the writer discusses air-line specialist shops. He finds two approaches by which the air line attains high-production levels in its maintenance. One is that of close air-line collaboration with the manufacturer's production staffs to assure absorption of all quantity-output data. The other is the specific designation of an organization to serve any air line in cooperation with all manufacturers. It is explained that in ultimate result the two approaches are identical. Both approaches are discussed in considerable detail and a preference is expressed for the second as representing the better solution to the subject. *American Aviation*, February 1, 1943, pages 48, 49, 1 illus.

Management

Tool Control. Charles H. Brown. An efficient system for the control and expediting of tools is outlined. The system is said to afford six primary advantages to the tool control section: knowledge of the status of each tool at all times; follow-up of any single tool change throughout the chain of component and interassembling parts; immediate location of any item; control of the use of imperfect tools or tools for parts that are imperfect; avoidance of tool mistreatment and unauthorized altering of fixtures; facilitation of small-tools movement and necessary processing of larger fixtures. The basis of the system is a cross-reference method between two records, a parts card and a tool card. On the parts card appear the part (or assembly) name, the part number, next assembly number, and quantity required per plane. Space is provided for notation of the models on which the subject part or assembly is required. Each tool number is represented by a tool card, in addition to its other functions, which furnishes a cross reference to the parts card. Ways of indicating directive and restrictive orders are explained. *Aero Digest*, January, 1943, pages 229, 230, 257, 5 illus.

Air-line Engineering Management. Ivor Lusty. In this fifth installment of a series of articles on the engineering management of air lines, repair and overhaul organization is discussed. Details are given for the layout and operation of factories for the repair and overhaul of replaceable units. A suggested layout is described, along with the routine of keeping records and determination of costs. Information is given on the maintenance of supplies and tools, classification of labor, testing, inspection, and other matters. *Aircraft Engineering*, December, 1942, pages 338–340, 1 illus.

Pre-Production Planning. D. Tiranti. Consideration is given to preproduction planning with particular attention to the allocation of time to departments. It is recommended that the time factor be set by an official or by a special department. A specimen type of chart for time allocation is presented. *Aircraft Engineering*, December, 1942, pages 361, 362, 1 illus.

Materials

Annual Engineering Review of Metals and Alloys. The major part of the current issue of *Metals and Alloys* is devoted to an engineering review of developments in metals and processes during the year 1942. The review is departmentalized into sections devoted to the production of metals, foundry practice, metal working and treating, materials and engineering design, and testing, inspection, and control.

Reviewing activities in the aluminum and magnesium industries, attention is directed to the rapid expansion that has taken place during the past year. Reasons for the rapid expansion in aluminum production are presented, a major one being standardization of design which became particularly feasible with the increased demand for aluminum products. Discussing the production revolution that has taken place in magnesium, it is explained that while aluminum expansion has involved no basically new production processes, a large proportion of the new magnesium capacity represents the introduction and use of magnesium-producing methods not employed in the United States before 1941, and some of them not used anywhere before then.

Reference is made to electrolytic and chemical magnesium-producing processes that have greatly facilitated

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mass production. Developments in the manufacture of aluminum and magnesium castings are discussed in another article. Reference is made to high-pressure die casting and to new developments that have made possible the welding of magnesium alloys.

In an article on forging it is noted that the aircraft industry, where safety and weight displacement are prime factors, has made especially heavy the demands on drop-forging engineers. The writer points out that an outstanding feature developed by the forging industry was the reduction of fatigue failures by elongating the grain structure. Mention also is made of the successful manufacture on a production scale of forged aluminum-alloy aircraft-engine cylinder heads.

How the knowledge of the heat-treatment of nonferrous metals gained in peacetime has aided the production of war materials is described in an article on the heat-treatment of nonferrous alloys. The dominant role that welding continues to play in aircraft manufacture and repair, particularly in the arc and gas welding of frames, is described in an article in which the writer discusses atomic hydrogen welding and other wartime aids. The rapid strides in the development and application of resistance-welding processes, welding machines, and controls are outlined in another article. *Metals and Alloys*, January, 1943, pages 50–100.

Made-in-Australia Magnesium. The writer discusses the importance of magnesium in aircraft manufacture and tells how it is being produced in large quantities in Australia. The process used at Newcastle for the production of magnesium is described. The properties and uses of this metal are outlined. *Aircraft*, December, 1942, page 22, 2 illus.

Medicine

Selection of Military Aircraft Pilots. Capt. Jose Raul Delucchi. General concepts in the professional selection and psychologic examination of military aircraft pilots are presented in a paper read before the Aero-Medical Club, Mayo Clinic, Rochester, Minn.

Fifteen elementary principles of professional selection are listed and discussed. The remainder of the paper deals with psychologic procedures in the selection of pilots, it being explained that there are two kinds of examinations, namely, the selective and initial examination and the control examination. Emphasis is placed on the importance of carrying out both examinations completely. *The Journal of Aviation Medicine*, December, 1942, pages 234–244.

Nutrition in Aviation Medicine. Lt. Howard R. Bierman. Consideration is given to the nutrition of military aviators as a factor in the maintenance of physical fitness. The importance of a special diet is stressed. It is recommended that a diet high in proteins, moderate in carbohydrates, and fairly low in fats be provided. Information is furnished on the vitamin content of the diet. Obesity, preparation of foods, excess gas in the intestines and air sickness are discussed in their relation to the diet. For aviators actively engaged in military operations, a regimen of small frequent feedings is recommended. The need for further research in the field of nutrition for the aviator is emphasized. *War Medicine*, January, 1943, pages 1–19.

Medicine. Comdr. L. D. Carson. An outline of the duties of a naval flight surgeon, supplemented by a consideration of the physiologic problems imposed by high-altitude flying. The problems touched upon are anoxia, aeroembolism, and low temperature. Data are included on the development and contributions of preventive medicine, and the flight surgeon is commended for his ability, versatility, and courage. *Flying*, February, 1943, pages 160–162, 232, 234, 8 illus.

Myocardial Damage Resulting from High Oxygen Tension. Julius Kaunitz. The writer describes experiments with mice subjected to an atmosphere of pure oxygen. The pathologic changes that occurred were bronchial obstruction, pulmonary atelectasis and edema, visceral congestion, and myocardial degeneration. It is held that the changes found in the respiratory system were responsible for anoxemia, and this, in turn, for the myocardial lesions. *The Journal of Aviation Medicine*, December, 1942, pages 267–271, 2 illus.

Neuropsychiatric Program for a Replacement Training Center. Lt. Col. Leland E. Stilwell and Major Julius Schreiber. An outline is presented of a neuropsychiatric program that was prepared for a replacement training center. The program was developed because it was found that in a great percentage of cases disorders in men coming into the training center were not being recognized. The more commonly encountered neuropsychiatric disorders are described, and the problems of the special training unit and the type of soldier who might be sent there are discussed. In a résumé the functions of a neuropsychiatrist for a training center are discussed. Brief mention is made of the need for a positive preventive program for military use. The actual operation of a neuropsychiatric program for a replacement training center is described. *War Medicine*, January, 1943, pages 20–29.

The Typical American Flyer. Hickman Powell. The writer tells how the Aero-Medical Research Laboratory at Wright Field and Prof. Ernest A. Hooton, physical anthropologist of Harvard University, together worked out a program of physical research to classify the physical characteristics of the American airman. It is explained that research was started after it was realized that designers of flying equipment, such as oxygen masks, did not have enough precise knowledge of the shape and size of the men who were going to use it. Plaster casts of composite United States flyers' heads are illustrated, and measurements are listed. *Popular Science*, March, 1943, pages 96–101, 223, 224, 12 illus.

A Study of Three Hundred Non-Selected Aviation Accidents. A. J. Herbolsheimer. In this study of the relationship of accidents to physical impairments, a group of pilots with listed defects of varying degree is compared with a group in whose records no defects appeared. A chart is presented showing the distribution of accidents of the two groups. A second chart shows the percentage of accidents of the two groups, considered separately. The advantages and disadvantages of this method of comparison are discussed. Basic reasons for pilot error are classified and analyzed. *The Journal of Aviation Medicine*, December, 1942, pages 256–266, 2 illus.

Effects of Centrifugal Acceleration on Living Organisms. George C. Ham. This article covers an extensive discussion of the effects of centrifugal acceleration on living organisms. The writer points out that in combat maneuvers and dive bombing the pilots of modern airplanes may suffer profound disturbances of circulation, vision, and consciousness. Because this factor limits the military effectiveness of combat planes, further development is now a physiologic as well as an engineering problem. Reference is made to the inadequacy of present knowledge of the physiologic effects and pathologic changes resulting from centrifugal acceleration and of methods of protection. The subject is discussed under sections

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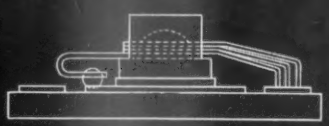

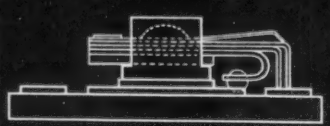

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covering observations of human beings in planes, observations of human beings in centrifuges, observations on animals, and the tolerance and protection of pilots. *War Medicine*, January, 1943, pages 30–56.

Air Sickness in a Primary Air Force Training Detachment. Capt. Herschel J. Rubin. The problem of air sickness as observed in a primary Army Air Forces flying training detachment is evaluated. Statistical data on observations are presented. Information is furnished on several types of treatment for air sickness which were employed. The conclusions drawn from the study are enumerated. *The Journal of Aviation Medicine*, December, 1942, pages 272–276.

***d*-Desoxyephedrine.** A. C. Ivy and F. R. Goetzl. This is a review of the effects of *d*-desoxyephedrine on man, which was prepared because this drug is apparently being used by the German armed forces and also because a review of the literature of the pharmacology of the drug has not been published. The subject is dealt with under sections covering chemistry and nomenclature; toxicity and dose; effects on mental and psychomotor activities; effect on blood sugar and heart rate; respiration, metabolism, temperature, blood sugar, blood picture and diuresis; waking and antinarcotic effect; habit formation, tolerance and cumulative effects; and other uses for human beings. *War Medicine*, January, 1943, pages 60–77.

Metallurgy

Powder Metallurgy. Franklin M. Reck. New methods for making machine parts from powdered metal, as developed at the Amplex Division of Chrysler Corporation, are described. The processes of mixing the powdered metals, forming in the briquetting press, sintering, and pressing to size are covered briefly, showing that a high degree of accuracy and uniformity is achieved without machining and in a minimum of time. It is noted that there are four classes of manufacture, according to the porosity of the product desired. An example of the economy of the process is cited showing that the cost of the dies is dependent upon the density of the product and that quantity production results in cost savings. Other advantages are found in relieving demands upon machine tools. *Aero Digest*, January, 1943, pages 170, 173, 174, 9 illus.

Metallurgical Features of NE Steels. In this article the metallurgic characteristics of the National Emergency steels are discussed under sections covering the Jominy end-quench

hardenability test, the heat-treatment of NE steels, how to interpret Jominy results, NE alloy steels carburizing grade, NE alloy steels medium hardening grade, and NE alloy steels high hardening grade. *Heat Treating and Forging*, January, 1943, pages 36–39, 1 illus.

Meteorology

Some Practical Relations Involving the Vertical Wind Shear. Robert D. Fletcher. The purpose of this paper is twofold. It is offered in the hope that the relations discussed will promote a more intensive study of the upper air conditions and reduce the fairly common practice of overlooking information of definite forecasting value extractable from the upper winds. The second purpose is to present examples of the vector method of approach to meteorologic problems and to show the simplicity with which the desired results can be obtained. It is shown that relationships involving the variation of wind with height based upon the assumption of horizontal, unaccelerated motion of an inviscid atmosphere have long been known but have only recently been put to practical use. The discussion is developed by consideration of the horizontal distribution of temperature, the potential temperature field, the field of specific volume, advective temperature changes, advective stability changes, and advective pressure tendencies. It is concluded that although other methods can be used the vector method is more logical. *Bulletin of the American Meteorological Society*, November, 1942, pages 351–365, 8 illus.

Aerology. Comdr. H. T. Orville. This article is concerned with the part played by the aerologist in naval effectiveness. It explains the vital necessity of weather calculations in connection with airplane operations and tells how the system now used by the U.S. Navy was developed during peacetime. To illustrate Navy aerology at war, part of the article is devoted to relating the experiences of a Navy aerographer with the American Volunteer Group in China.

The southwest Pacific ocean is indicated as one of the most difficult areas aerologically. However, the fact that most of the battles in the Pacific have been waged in weather favorable to the U.S. Navy is pointed to as evidence of the efficiency of its aerology division. The weather in the Atlantic is said to be much more predictable. *Flying*, February, 1943, pages 140–142, 288, 294, 7 illus.

El Plan Integral de los Servicios Meteorológicos (The Integral Plan of the Meteorological Services). Carmelo Di Corleto. The concluding installment of this article continues with the description of meteorologic instruments and devices to be applied in the work of the ground organizations. The writer explains the operation of the meteorologic network and shows how a pilot is able to plot his course according to meteorologic data received at the airport. *Mundo Aeronautico*, November, 1942, pages 21, 22, 24, 27.

Military Aviation

The Germans Have a Wasting Air Power. Lt. Gen. Henry H. Arnold. The Commanding General, Army Air Forces, presents an analytical review of America's growing air power. He tells of the cooperation that has been built up between air, ground, and sea services and describes the scope and thoroughness of Air Forces training. The outstanding performance of American military aircraft in the various war theaters is related. *U.S. Air Services*, January, 1943, pages 10–13, 2 illus.

Why Not Four Engine Fighters? Keith Ayling. The writer considers the possibilities of a heavily armored four-engined type of fighter and states that there are many signs already pointing to the eventual displacement of the single-seater fighter by a four-engined battleship of the air. Reference is made to the fact that the fighter plane designer has had to make sacrifices in armor, armament, and range in the interest of speed and climb. It is noted that the modern fighter has a comparatively high ratio of vulnerability and that the fighter pilot, in his $100,000 plane with its 2,000-hp. engine, is highly expendable. Efforts to increase fighter range are described. Discussing the performance in action of large, heavily armed and armored planes, figures are quoted indicating the large number of enemy planes that were put out of action by Fortresses and Liberators in the big daylight raid on Lille as compared with the few planes destroyed by a much greater number of escorting fighters on various types. It is stated that, minus its bomb load, the fire power of a Flying Fortress could be doubled. The design of a hypothetic four-engined fighter is outlined, taking the B-17E as a basic pattern. What might be accomplished by eliminating a bomb load of 4 tons and fitting four 2,000-hp. engines is visualized. *Model Airplane News*, February, 1943, pages 6, 7, 46–48, 50, 6 illus.

Army Co-Op Mustang. Major F. A. de V. Robertson. An outline of the functions of British Army Cooperation Command is supplemented by a description of the Mustangs with which their units are equipped. Although these units are primarily tactical reconnaissance squadrons, they are also trained in ground strafing and artillery observation. Their value in the event of a second front is noted.

The structural features of the Mustang, as well as the arrangement of its armament and equipment, are illustrated by drawings. Attention is called to the fact that its radiator is placed under the fuselage, aft of the wing. *Flight*, December 10, 1942, pages 627–630, 8 illus.; "The Offensive Against Enemy Transport," *The Aeroplane*, December 11, 1942, pages 680, 681, 3 illus.

Brief History of the U.S. Army Air Forces. Major Nathaniel F. Silsbee. The writer reviews the development of the Army Air Forces from August 2, 1909, to the present. He also describes how the air arm of the U.S. Army is meeting the test of global warfare. Closing paragraphs cover the organization of an air force and air force components. *National Aeronautics*, January, 1943, pages 17, 18, 32, 7 illus.

They Cover the Sea Lanes. Activities of the bomber-reconnaissance squadron of the Royal Canadian Air Force are described. How enemy submarines are located and attacked is outlined. *Canadian Air Cadet*, January, 1943, pages 15, 23, 2 illus.

Air Carriage. Contaire. The abilities and limitations of air transport in warfare are described. Discussing mobility, the writer states that the tactical mobility of the airplane is extremely high, while its strategic mobility is correspondingly low because it must operate from specially prepared bases, requires a high degree of maintenance, and has a high rate of fuel consumption with limited fuel-carrying capacity. It is stated that the question of whether or not there is need for more strategic mobility depends on the type of aircraft and the form of operation for which it is to be used. Consideration is given to the problem of improving mobility where needed. *Aeronautics*, January, 1943, pages 38, 39.

An Airborne Division. Major F. A. de V. Robertson. With emphasis on the versatility required of airborne troops, their methods of operation are related. Details are given on their equipment, training, and qualifications, and explanation is made of how they differ from para-

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chute troops. The British Army and Royal Air Force are commended for their cooperation in the direction of air-borne divisions. *Flight*, December 10, 1942, pages 635–637, 2 illus.

Suzy-Q. Caroline Iverson. This is the story of a Flying Fortress which is back in America after a year of action in many theaters of the war. The writer tells how this flagship of the 19th Heavy Bombardment Squadron, which never had fighter escort, made a 35,000-mile trip around the world in addition to flying many miles on combat missions. It is stated the plane was flown over 1,000 hours without a major repair. *Life*, January 18, 1943, pages 82–84, 86, 88, 90, 92, 15 illus.

The Flying Dutchmen of Dixie. Hermann B. Deutsch. The courage and tenacity of the Dutch people are shown by several anecdotes of how trainees reached the Royal Dutch Air Force, now based at Jackson, Miss. The narratives tell of escapes from Nazi prisons and jungle airports in the Dutch East Indies. Contrast is offered by a description of the men's reactions to American customs in Mississippi. *The Saturday Evening Post*, January 23, 1943, pages 18, 88–90, 2 illus.

Naval Aviation

The Navy's Air Arm, by Col. Frank Knox; **The Job Has Just Started,** by Hon. Artemus L. Gates; **The Flyer Fights the War,** by Adm. Ernest J. King. Three editorials introduce this issue of *Flying*, which is entirely devoted to U.S. Naval aviation at war—one is by the Secretary of the Navy; the second by the Assistant Secretary of the Navy for Air; and the third the Commander-in-Chief of the United States Fleet. All three tell how vital naval aviation is to the successful conduct of this war and what an integral part of the Navy aviation has become. They also report on the decisive role played by aviation in the past year's naval battles and emphasize its importance in the battles to come. Spurring the country on to greater effort, they commend U.S. Naval air personnel, equipment, and production. *Flying*, February, 1943, pages 47, 48, 49, 286, 3 illus.

45,000 Ton Battleship-Aircraft-Carrier of the Future. A brief description is supplemented by cutaway drawings of a suggested design for a combination battleship and aircraft carrier of approximately the size of present-day battleships. One of the ideas advanced is in the design of the flight deck, which is of conventional construction amidship but has retractable extensions fore and aft. These extensions are intended to be moved out to cover the main decks for launching and landing planes. On the main deck there are turrets carrying 16-in. guns, similar to those used on current battleships. The secondary batteries of 5.25-in. guns, anti-aircraft guns, and machine guns are like those of modern battleships. Provision is made for the storage and operation of bombing planes in a manner similar to aircraft carriers of the present, in addition to which the ship would be equipped with 15 fighter planes, carried mainly for the protection of the ship. Numerous other design features are described. *Aircraft* November, 1942, pages 24, 25, 3 illus.

Buaer. Rear Adm. John S. McCain. In a brief summary, the Chief of the U.S. Navy Department, Bureau of Aeronautics, reviews the work of the Bureau during the United States' first year of participation in the war and outlines its purpose. He affirms that the Bureau's principles, formulated in peacetime, have proved their value when tested by a global war and that it has been successful in supplying the U.S. fleet with the kind of airplanes and aviation personnel needed. But he stresses the urgency for increasing the quantities of both. An organization chart of Buaer is included in the article. This shows the relative positions of the Chief of the Bureau, Chief's office, Assistant Chief, Administration Financial Progress, and the directors of planning, material, maintenance, personnel and training, and flight. *Flying*, February, 1943, page 50, 1 illus.

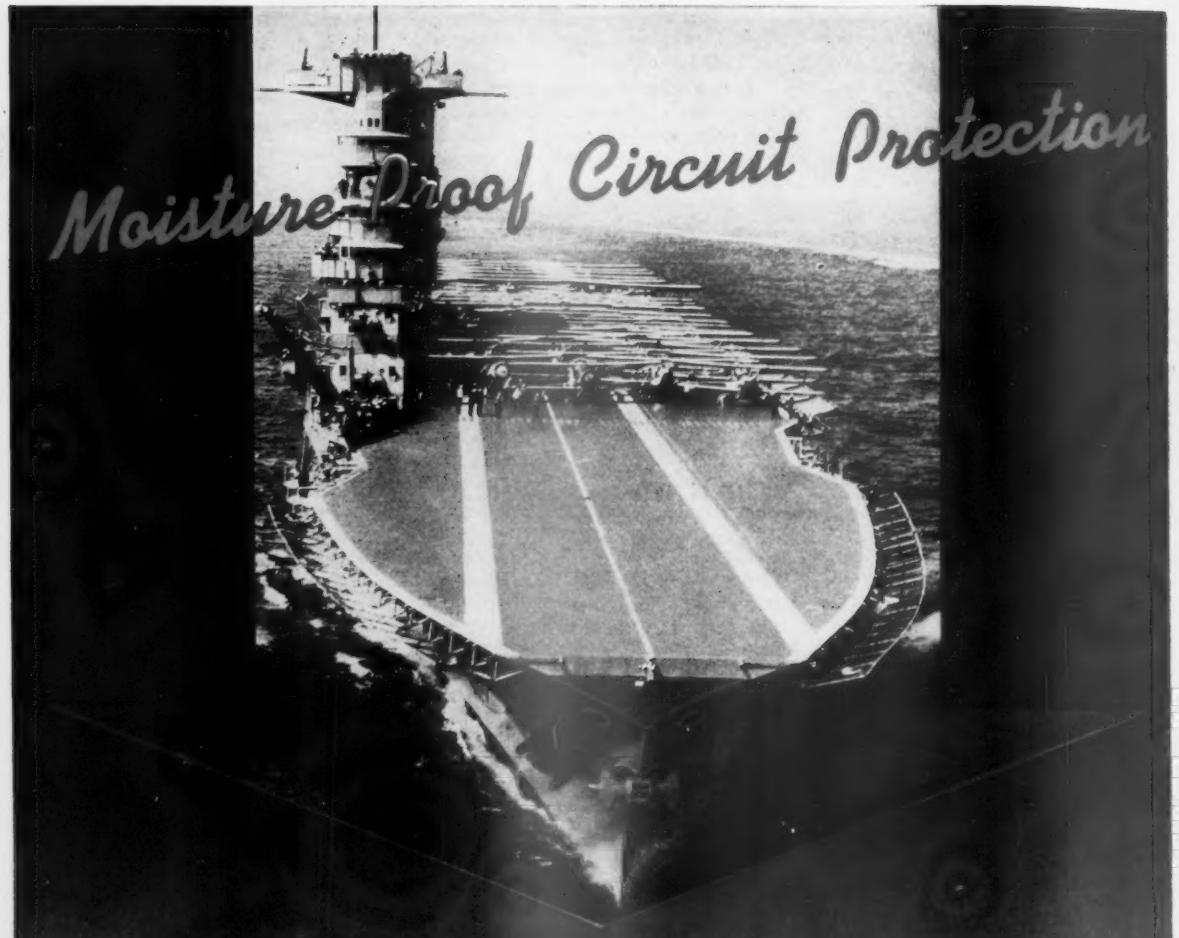
The Fightin'est Wings of All. Major Gen. Ralph Mitchell. Preceded by an editorial message from the writer, this is a brief account of Marine aviation, its history, and its achievements. Incidents are related which portray the fighting spirit of the corps, emphasize its teamwork, and show the innumerable times it has been victorious against great odds. The action at Midway is noted particularly. An interpretation of the purpose of Marine aviation describes it as twofold: first, to give aerial support to Marine land operations; second, to serve as replacement squadrons for the Navy. *Skyways*, February, 1943, pages 18–21, 61, 9 illus.; "The Marines," by Major Gen. Ralph J. Mitchell, *Flying*, February, 1943, page 104, 1 illus.; "The Marines Are in the Air," by Charles S. Strong, *Air Life*, March, 1943, pages 16–19, 44, 45, 6 illus.

The Battles. A compendium of all air battles participated in by the U.S. Navy after Pearl Harbor. Major operations up to, and including part of the Solomon battles are given. The engagement headings are: Marshall and Gilbert, Bougainville, Wake and Marcus Islands, Salamaua and Lae, Tulagi, Coral Sea, Midway, the Aleutians, and the Solomons. Enemy losses are listed for each battle. *Flying*, February, 1943, pages 71–76, 192, 199, 200, 14 illus.; "Navy Pitching, Japs Catching," by Lt. Fred Tupper, Jr., *Western Flying*, January, 1943, pages 34, 35, 82, 5 illus.

Growing Pains of the Fleet Air Arm. A monograph is presented on the organization and duties of England's fleet air arm, and on its strategic function. The history and development of the unit are traced. Particular attention is given to the aircraft with which it is equipped and to its personnel. Comparisons are made with the Royal Air Force and with the air forces of the U.S. Navy. *Aeronautics*, January, 1943, pages 48, 49.

The Carrier. Rear Adm. Frederick C. Sherman. The writer supports the case of the aircraft carrier. Urging the building of enough carriers to use them offensively, he states that in his opinion the only way to win the war in the Pacific is with a superior carrier force. He refutes various arguments on the vulnerability of aircraft carriers and cites of "Lexington," of which he was commander, as an example that they can withstand punishment as well as mete it out. The development of carriers is touched upon, comment is made upon the relative merits of Japanese and United States carrier forces, and a description is given of routine life aboard an American aircraft carrier in peace and in war. *Flying*, February, 1943, pages 77–80, 229, 230, 8 illus.

The Fighter. Lt. Comdr. John S. Thach. Illustrating the purpose and tactical strategy of fighter planes, the routine of a fighter pilot's day during offensive operations aboard a carrier is detailed. Preceded by an explanation of what control of the air is and its importance, the fighter plane's specific mission is designated as the achieving of control of the air. In testimony of the fighter's advantage in plane-to-plane combat, Germany's present situation with regard to the British Isles is offered. *Flying*, February, 1943, pages 81–84, 244, 247, 6 illus.



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Aircraft Carriers of the Combatants. The number, specifications, and design of United Nations and Axis aircraft carriers are surveyed. Comparisons are made between the types built by each country and a report is given of carriers that have been lost on both sides. In submitting information the discussion is not limited to the general subject but mentions carriers specifically by name. The writer also makes several predictions with regard to the future of the aircraft carrier, all of which stress its growing importance. *The Aeroplane*, January 1, 1943, pages 14–17, 12 illus.

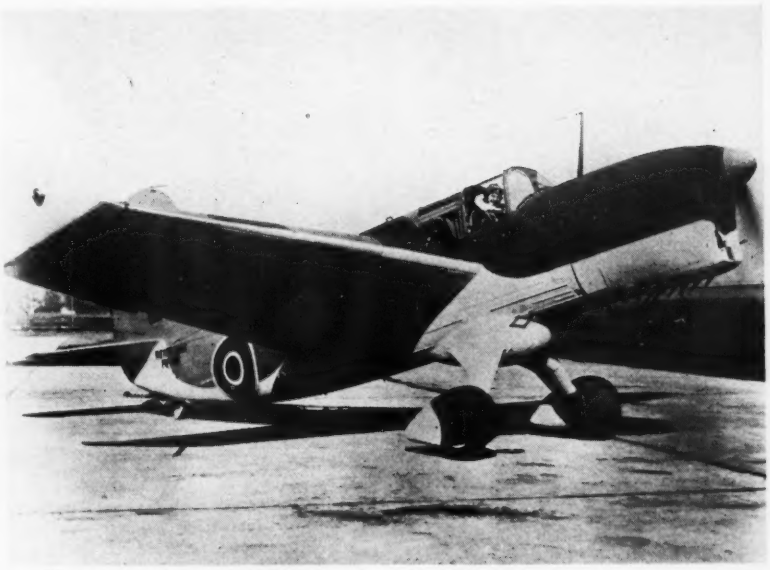
Scout Bomber. Col. Ira L. Kimes. A study of the construction and characteristics of the naval scout bomber, the history of its development, and the scouting and attack missions for which it is employed. The contributions of this type of bomber toward winning sea battles, as demonstrated by actions between American and Japanese forces, are also reviewed. The operations noted are those in connection with the raids on the Marshall Islands, Wake Island, Marcus Island, the battles of the Coral Sea and Midway Islands, and the initial stages of the action against the Solomon Islands. *Flying*, February, 1943, pages 85–88, 280, 288, 10 illus.

Aerial Torpedoes. The writer discusses the record of torpedo planes in the present conflict, describes the mechanism of the torpedo, and tells how torpedo attacks are carried out. *Canadian Air Cadet*. January, 1943, pages 9, 26, 2 illus.

Scout Observation. Comdr. M. K. Fleming, Jr. The work of the observation-scout pilot is outlined. With his qualifications listed, the article indicates how he maintains his constant vigil over shipping lanes and convoys and serves as the eyes of the task force or combat ship. A brief description is given also of the general characteristics of scout-observation planes. *Flying*, February, 1943, pages 89, 90, 4 illus.

Balance of Flat-Topped Power. The writer discusses the aircraft-carrier strength of the United States and British fleets and states that the danger point in the loss of carrier strength of these countries has been passed. He points out that for every carrier lost the United States soon will have acquired two. Reference is made to the new American carriers recently launched and to the large number of carriers converted from merchantmen which are being produced by this country. It is noted that British carrier strength is greater than it was before the war. *Time*, January 25, 1943, page 58, 1 illus.

Patrol Bomber. Comdr. T. R. Frederick. An account of the varied functions of a naval patrol bomber. The article lists the specifications for patrol bombers and names the Navy types which many years of development have evolved .... in the landplane category, the PB4Y-1 (the Liberator), and the PV-1, 2, and 3 (Navy versions of the Vega Ventura); in the seaplane category, the PBY-5 (the Catalina), the PBY-5A (an amphibian version of the PBY-5), the PB2Y-3 (Coronado), and the PBM-3C (Mariner). It then goes on to describe the jobs performed by the bombers: long-range patrol missions, antisubmarine patrol and convoy guarding, rescue work, bombing naval objectives ashore and afloat, torpedo attack, mine-laying operations, and naval transport. Exploits are related to illustrate some of these. Differentiating between landplane and seaplane types of aircraft, the article also includes an explanation of why the Navy requires landplanes as well as seaplanes for its operations. *Flying*, February, 1943, pages 91–96, 297, 11 illus.



The new Curtiss SO3C-1 Seagull scout-observation type, now being delivered to the Royal Navy of Great Britain, will be known as the "Seamew" (British designation). This two-place, mid-wing monoplane is designed to be operated on scouting missions and to serve as "the eyes of the battle fleet." The plane may be interchangeably equipped with wheel or flotation landing gear.

Torpedo Bomber. Comdr. Donald E. Wilcox. The advantages of torpedo bombers in naval combat are recorded. Comparison is made between the action of torpedo bombers with that of dive and high-level bombers and between torpedo bombers and submarines, destroyers, and cruisers. It is stated that the torpedo's chief value is its ability to deliver a knockout blow beneath water, where damage to a vessel is most likely to be fatal. Although ships can inflict this underwater damage, it is said that their lower speed and greater vulnerability do not afford them the same chances of success that airplane operations have. The writer describes the improved qualities of the new TBF Avenger over the planes used early in the war, in answer to critics of torpedo bombers who base their objections upon past action in the Pacific. *Flying*, February, 1943, pages 97–99, 4 illus.

The Enemy. An estimate of Japanese characteristics with bearing upon the Nipponese ability as airmen. The Japanese is pictured as a highly trained fighter, of little imagination, remarkable stamina, and fanatically indoctrinated with the spirit of killing. Although he is acknowledged to be persistent and courageous, it is said that his quality as an air fighter is due more to thorough training than to any inborn combat ability. In the face of an emergency it is indicated that he is apt to go to pieces. The national tendency toward suicide is analyzed. Excerpts are quoted from an article written by one of the members of the British Naval Air Mission to Japan in 1921, and a description of the Zero fighter plane is included. Comment is made also upon Japanese bombers, aircraft carriers, and gunnery training. *Flying*, February, 1943, pages 100–103, 206, 219, 220, 10 illus.

Paratroops. Lt. Col. Louis E. Marie. The physical requirements of U.S. Marine paratroopers, the training they undergo, and their ultimate mission are described. Based upon past use of paratroops by the enemy,

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Increased range and fire power was the logical result when the U. S. Navy pioneered development of dive bombers which now pace our winning fight on the seven seas.
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BREWSTER Blasters
BUCCANEER AND BERMUDA DIVE BOMBERS

their purpose is divided into two general classifications: sabotage and combat operations in conjunction with other forces. Seizure of vital points, such as airfields, bridges, etc., is listed as one of their primary purposes in tactical operations. The writer indicates certain factors necessary to their maximum effectiveness. He also gives a brief summary of the history of paratroops and remarks upon the high morale of U.S. Marine parachute troops. *Flying*, January, 1943, pages 105–108, 294, 296, 7 illus.

The Coast Guard. A detailed survey of the history, expansion, functions, equipment, and record of Coast Guard aviation. An integral part of the U.S. Navy, Coast Guard aviation activities fall into three general classifications: (1) patrol, (2) search, (3) convoy coverage. While Coast Guard air stations and planes are manned and operated by Coast Guard personnel, the closest possible liaison is maintained with the Navy Bureau of Aeronautics, there is a Naval Intelligence Officer attached to each station, and additional planes are procured as necessary from the Navy. Some rescue exploits are related and the qualifications for Coast Guard aviation training are listed. *Flying*, February, 1943, pages 114–116, 280, 288, 6 illus.

Convoy. Comdr. A. B. Vosseller. An account of how airplanes, working in close cooperation with surface escort units, protect convoys and vanquish the submarine evil. In evidence of the fact that the use of aircraft in conjunction with the convoy system has greatly increased its effectiveness, aircraft operations against under-ocean craft are described and their psychologic as well as actual usefulness against submarine personnel is emphasized.

The change in convoy strategy since the last war is discussed, as is the increase in the number of submarines used by the Germans and their evolution of wolf-pack tactics. It is stated that although submarines have a high surface speed compared to the usual merchantmen they are easy prey for airplanes. In connection with the types of aircraft used for aerial escort, flying boats and fighters are noted primarily. *Flying*, February, 1943, pages 135–137, 226, 229, 6 illus.

Air Intelligence. Comdr. Frank W. Wead. The duties of an air combat intelligence officer in the U.S. Navy are outlined. These consist of the gathering and disseminating of all battle data. In many respects—particularly in the instruction of air crews before the battle and their interrogation after it—the duties are said to be similar to the air intelligence functions of the U.S. Army Air Forces and the R.A.F. Other duties of the air combat intelligence officer involve extensive knowledge of the areas in which they are operating; recognition of ships and aircraft; and the maintenance of intelligence material and files, charts, and maps.

An example is given of how air combat intelligence functions at sea. Data are included also on how officers for this division of naval service are trained and assigned. *Flying*, February, 1943, pages 163, 164, 4 illus.

The Catapult. Comdr. J. A. Haley. After briefly tracing the development of catapults, the advantages of their utilization on warships are explained and their further applications for commercial purposes are predicted. Data are given on the different types of assisted take-off methods used for cruiser, battleships, and carriers.

It is stated that, with basically similar mechanical systems, there are now three types of catapults in general service—powder, air, and hydraulic. The lightest catapult available, provided air compressors and stowage tanks are part of the ship's equipment, is the air catapult, which is installed on some U.S. cruisers. The powder catapult is used on battleships and cruisers, and the hydraulic type catapult is used exclusively on aircraft carriers and auxiliary aircraft carriers. *Flying*, February, 1943, pages 167, 168, 4 illus.

The Waves. Lt. Joy Bright Hancock. Data are given on the W.A.V.E.S., said to be the first officer and enlisted reserve in any military service in the United States to be composed entirely of women. Their purpose, organization, qualifications, training courses, ratings, rates of pay, officers' qualifications and training, and the kinds of jobs they are expected to take over are described. Limited to duty within the continental limits of the United States, the jobs listed include technical ones such as aviation machinist's mates, aerographer's mates, parachute riggers, etc. (for which the Navy will train these women); radio operators, stenographers, telephone operators, and other clerical workers; cooks, chauffeurs, photographers; and many others that can be assumed by women and which will release men for combat duties. In relating the background of the W.A.V.E.S., the article reviews briefly the activities of the yeomanettes during the first World War. *Flying*, February, 1943, pages 182, 183, 247, 249, 254, 4 illus.

Life-Saving Equipment. Comdr. James E. Sullivan. The various devices used by the U.S. Navy for protecting and rescuing their air crews from the sea are surveyed. The article also covers the design requirements for safety equipment. Among the equipment described are: the safety belt, the parachute, the pneumatic life jacket, and several types of life rafts. A few incidents of rescues from life rafts are related. *Flying*, February, 1943, pages 185–188, 296, 297, 13 illus.

Personalities

Leaders of the Luftwaffe—XIV. H. J. A. W. Major-Generals Eugen Meindl and Bernhard Ramcke are the subjects of the fourteenth installment of an article portraying the men in command of the Luftwaffe. Now associated with the direction of parachute troops, both men were originally Army officers. Their efforts to apply the combined strategies of air and land operations are characterized by the article as being courageous and able. A veteran of Norway and Crete, Meindl was later placed in command of the Parachute Division on one of the Russian fronts. Ramcke has fought in Poland and Crete and is believed to be serving now in Africa. *The Aeroplane*, December 11, 1942, pages 675, 2 illus.

Leaders of the Luftwaffe—XV. H. J. A. W. Brief details are given on the characters and careers of Theo Osterkamp and Kurt Pflugbeil. The first is a major-general commanding fighter groups, the second is a general, commander of the Fourth Air Corps. Both are veteran pilots, decorated for their courage and achievements. Politically a radical conservative rather than a true Nazi, Osterkamp is said to be well liked by his superiors and those under him. He was last known to be serving on the Russian front. After having taken a large part in bombing operations against Great Britain, Pflugbeil too is reported as participating in air action against Russia. *The Aeroplane*, December 18, 1942, page 702, 2 illus.

Leaders of the Luftwaffe—XVI. H. J. A. W. The careers of Lieutenant-Generals Joseph Kammhuber and Kurt-Bertram Von Döring, commanding officers of the Night Fighter Division in Western and Eastern Germany, respectively, are outlined in this installment. Although both are flying enthusiasts and pilots of the first World War, it is said that they are good organizers rather than outstanding airmen or soldiers. Since neither Kammhuber nor Von Döring has the strength or the influence to secure the development of true night fighters, it is believed that their commands have suffered from German's belief in artillery. With regard to

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politics, it is stated that Kammhuber is not a Nazi; Von Döring's political affiliations are not mentioned. *The Aeroplane*, December 25, 1942, page 730, 1 illus.

Leaders of the Luftwaffe—XVII. H. J. A. W. The seventeenth installment of this series is concerned with Hans Geisler, Commander of the Tenth Flieger Corps, Southern Italy. His career is traced from 1909 when he joined the Navy as a midshipman. A veteran naval pilot, Geisler is designated as one of the Luftwaffe's best generals, well qualified to command operations requiring knowledge of sea and air. Although a stern disciplinarian, he is said to be liked and respected by his men. Politically, he is not a Nazi but has collaborated with the party in the rearmament of Germany.

A good part of this article is devoted to evidence that a unified air arm has been advantageous to Germany, terminating the old interservice rivalry. *The Aeroplane*, January 1, 1943, page 11, 1 illus.

Personnel

Legal Requisites for Labor Standards in the Aviation Industry. An interpretation of the basic points of two labors laws—the Walsh-Healey Public Contracts Act and the Fair Labor Standards Act. The extent of their applications to the aviation industry is defined. *Aviation*, January, 1943, pages 127, 319, 320.

Photography

Photography. Capt. L. A. Pope. The naval aerial photographer's job is twofold: first, he maintains constant watch of the enemy's coastlines and vessels, furnishing information for combat; second, he establishes a permanent record of the naval battles that take place. The value of both phases of aerial photography to the Navy are explained by the writer who also describes aerial photography interpretation and identifies it as an indispensable part of winning sea battles. Another designated function of the camera is the provision of a visual basis for flight improvement. *Flying*, February, 1943, pages 131–134, 275, 8 illus.

Plants

Texas Aircraft Plants Grow Big. Tom Ashley. An announcement of new additions to Consolidated's Fort Worth plant and North American's Dallas plant is supplemented by some details on the new factories. At North American, facilities have been added to produce bombers and fighters in addition to the trainers that are now being manufactured there. Although exact dimensions of the new buildings are restricted information, some idea of the expansions is given by the article. *Southern Flight*, January, 1943, pages 46–48, 4 illus.

Plastics and Plywood

Low Pressure Laminates for Aircraft. Powel Crosley, III. An article describing how Crosley Marine of Miami, Fla., has developed methods for fabricating complex curved and shaped laminated plastic parts practically without pressure. It is explained that with this process molds of cheap wood, plaster of Paris, and concrete are used instead of complex dies and molds. The writer predicts that before the war is over it will be possible to fabricate aircraft completely by this low-pressure process. *Modern Plastics*, January, 1943, pages 54, 55, 148, 5 illus.

The Elastic Constants of Plywood. R. F. S. Hearmon. The effects of grain angle on the elastic constants of plywood are discussed. The work described was carried out by the Forest Products Research Laboratory. Through direct observation it was found that a bending moment parallel to the long axis in a strip of veneer cut at an angle other than 0° or 90° to the grain is accompanied by a twist and also that the resistance to bending is higher when accompanying torsion is prevented. Since it appeared likely that the torsion-flexure coupling and the intimately associated shear-extension coupling might have some bearing on the elastic constants of plywood as affected by grain angle, the matter was investigated. Questions of ultimate strength were not dealt with in the analysis. *Aircraft Engineering*, December, 1942, pages 336, 337, 340, 3 illus.

Strength Properties of Plexiglas. W. F. Bartoe. This first of a two-part article on the strength characteristics of Plexiglas discusses fundamental strength factors as well as impact-strength tests and results. Data are presented on the following: temperature, thickness, size and shape, preconditioning, rate of straining, and other factors. Several tables and graphs supplement the study. *Aviation*, January, 1943, pages 128–131, 135, 7 illus.

Aircraft Plywood and its Finishing Requirements. Charles A. Carter. The first part of a serial article on finishes for the protection of aircraft plywood deals with materials and methods used for sealing and impregnating the wood. The discussion centers around the specifications for control of moisture content, defines the ranges of temperature and humidity to be encountered, and describes the requirements for the sealer. Information is given on the processes of application, such as dipping, brushing, and spraying, and goes into detail concerning the characteristics essential for satisfactory results. Systems for the application of finishing coats and camouflage enamels, as produced by Aulcraft Paints Limited, are also discussed. *Commercial Aviation*, January, 1943, pages 94–96, 98, 11 illus.

Strength Characteristics of Plastic-Bonded Plywood. G. B. Parsons. In this paper the writer discusses some of the many advantages of plastic-bonded plywood and gives some of its pertinent basic strength characteristics. In opening paragraphs attention is drawn to new methods of molding plywood. It is stated that the bag process combined with new developments in the field of adhesives have opened up a wide range of possibilities for the use of plywood in aircraft construction. Gluing technique is said to be advancing rapidly, and it is predicted that in the near future a thin metal covering glued to a plywood core will be used to great advantage in airplanes having high-wing loadings. With such construction the high axial strength of the metals would be combined with the good buckling characteristics of the thicker plywood construction. *Transactions of the A.S.-M.E.*, January, 1943, pages 1–7, 7 illus.

Moulded Shell Construction in Plywood. Alexander Klemin. The Skydyne method of plywood aircraft construction is described. It is said to produce true monocoque molded shell wings, fuselages, and control surfaces that meet severe requirements of weight and strength. The writer defines the principles of construction and traces the origin of the system to an aeronautical engineer in France in 1936. The construction of a shell wing is detailed and comparisons are made with earlier methods. Principal advantages of the material are said to be in its thickness, stiffness, and bending resistance for a given weight, as well as flexibility of assembling the layers or plies. Remarks are made on the resistance to buckling or bending, these properties being compared with steel alloy,

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aluminum alloy, magnesium alloy, and plywood having mahogany face and poplar core. Different ways of constructing the fuselage are mentioned and it is indicated that other parts can also be made of the material. Advantages and possibilities of the material are summarized. *Aero Digest*, January, 1943, pages 148, 158, 160, 256, 257, 2 illus.

Aircraft from West Coast Timberland. C. E. Rozema. This article tells how lumber from the West Coast timberlands is finding increased application to plywood for aircraft. A study was made of West Coast equipment for the manufacture of plywood from woods available in that area. It was found that much of the equipment was not adaptable to the handling of the thin veneers required for aircraft. The manufacture of plywood for aircraft is described with the aid of illustrations. *Modern Plastics*, January, 1943, pages 68, 69, 134, 136, 4 illus.

Problems in the Use of Plywood in Airplane Construction. Alexander Klemin. Problems connected with the employment of plywood in the manufacture of airplanes are discussed. It is explained that the work of the committee has been divided into sections covering: aircraft veneer and plywood manufacture; selection, inspection, availability of materials, and specifications; adhesives and their application; special fabrication processes; plywood components of the airplane, fittings, and connections; airplane construction and assembly in relation to plywood; testing of plywood and plywood parts; strength properties of plywood; structural analysis; and bibliography.

Each of the subjects is discussed and the objectives of the committee are outlined. It is noted that the committee does not intend to study the manufacture of plywood but merely to draw attention to difficulties as the aircraft manufacturer is apt to see them. *Mechanical Engineering*, February, 1943, pages 105–109, 1 illus.

Design Considerations for Plywood Structures. L. J. Marhoefer. This installment deals with more specific consideration of the effect of grain angle, a factor that was briefly mentioned in previous parts of the article. Tests on plywood with various grain angles to the direction of load have formed the basis for a curve of the relative modulus of elasticity compared with the grain angle, which is offered as a start toward the evaluation of such data. Consideration is given to effective width of stiffened shell and compressive bending stresses, and stress calculations are tabulated for typical fuselage sections. Other factors analyzed are tension stresses, tension stringer stresses, and shear stresses. A method is suggested for obtaining accurate moduli of rupture. The reasons for and advantages of stress analyses are summarized. *Aviation*, January, 1943, pages 150, 151, 153, 348, 349, 4 illus.

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Bearing Strength of Plastics and Plywood. James Bond. To determine the bearing strength of commercially available high-impact molded and laminated plastics, tests were carried out in the materials testing laboratory of the University of Kansas. This paper reports the results of these tests. They indicated the superiority of reinforced plastics in bearing strength as compared with plywoods. It was found that in most cases heating improved the bearing strength of specimens. Soaking in water, on the other hand, definitely decreased their strength, as compared with results on specimens conditioned at room temperatures and a relative humidity of 55 per cent. Curves are shown for load versus deformation in per cent of bearing-pin diameter and load versus permanent set in per cent of bearing-pin diameter. *Transactions of the A.S.M.E.*, January, 1943, pages 9–14, 9 illus.

Private Flying

To Be or Not to Be. Leighton Collins. After a review of prewar commercial aspects of the aeronautical industry, suggestions are offered for the specifications of an airplane intended to be a commercial success. An airplane that, in addition to flying, will be able to perform many of the utility functions of an automobile is the writer's answer to the problem of making the airplane useful to the largest possible number of people at the least possible cost after the war. This solution, he claims, will remove the obstacles to having the private airplane provide the foundations for a major postwar industry: inflexibility (or the inability to carry the operator and passengers to the exact destination, thus necessitating auxiliary automobile transportation); large overhead costs (hangar space, etc.) and the problems of weather and darkness.

An "accordion fold" wing is suggested. The writer also suggests design features for a plane which can be simply operated and urges that construction of a plane that meets roadability requirements be instituted immediately on an experimental and engineering basis. The prospects for postwar careers for aviation personnel are discussed, as well as those for the future successful development of commercial aviation. *Air Facts*, February 1, 1943, pages 15–26, 10 illus.

Production

Electronic Devices and X-Ray Speed Aircraft Production. Electronic devices that are speeding aircraft production are described. One of these is the Triplett & Barton electronically controlled automatic X-ray unit used by Lockheed-Vega for the inspection of light-alloy parts. Electronic devices for dynamic strain gauging and spectrographic analyses are also described. Reference is made to electronic devices used in combat flying. Also mentioned is a radio-controlled model plane equipped with a radio-controlled parachute to permit landing without damage after the engine stops. This model is stated to be militarily useful as a target for antiaircraft practice. *Electronic Industries*, January, 1943, pages 45, 46, 109, 111, 8 illus.

Why Production Must Be Delayed for Modification. Major Oliver Stewart. Reasons are given why modifications in the design of military aircraft constantly must be made even at the expense of delayed production. It is explained that the increased complexity of fighting airplanes is largely due to the demand for more speed and more climb. The modern airplane represents a growth from the first design, having been modified in accordance with experience of those who have charge of its operation and maintenance. Design developments in some outstanding British military aircraft are outlined, and maintenance problems are discussed. *Aircraft*, December, 1942, pages 14, 15, 2 illus.

Multiline Production Speeds Flying Fortress Deliveries. H. Oliver West. An article describing how the Boeing Aircraft Company has speeded the production of the Flying Fortress by reversing the usual practice of assembling a plane into its final form at the earliest possible moment in manufacturing. It is explained that with multiline production major parts are built and assembled completely and are then joined together to form the complete plane. *Wings*, January, 1943, pages 301–306, 16 illus.

Radio-Frequency Heating of Aircraft Parts. John P. Taylor. In a paper that was read before the Institute of Radio Engineers the use of radio-frequency power for heating wooden aircraft parts is discussed. How tube-generated induction currents have been used to solve a problem connected with the production of compregnated wood propellers and to expand the production of box spars, truss-type rib constructions, bomber floors, bomb-bay doors and other aircraft parts is described. Sections of the article cover basic principles, time of heating, operating costs, the advantages of radio-frequency heating, and its merits compared with heating parts by steam. *Electronic Industries*, January, 1943, pages 50–52, 111–115, 10 illus.

Avro Lancaster. Wilfred E. Goff. This is Part I of a series of articles on the production of Britain's latest four-engined bomber. An extensive description is presented of how the center section and outer wings are manufactured. Preceding this description is a brief outline of how the Avro Lancaster is designed for quantity production. Details are given on the tools used. *Aircraft Production*, January, 1943, pages 10–22, 31 illus.

Widespread Conversions to Help the United States Meet 1943 Quotas. Leslie V. Spencer. The writer tells of the diversified types of plants which have been converted to the manufacture of airplanes and other war products. Among the companies he mentions are the H. J. Heinz Company, food producers; the Reynolds Metals Company; Steinway and Sons, piano makers; General Motors Corporation; and the Grand Rapids Industries, a group of former furniture manufacturers. Some of the problems attendant upon these conversions are listed. *Aero Digest*, January, 1943, pages 82, 83, 318–320, 6 illus.

Ingenuity Pays Big Dividends Noorduyn Factory Men Find. R. Eric Crawford. An outline of some of the improved practices developed by Noorduyn Aviation for the production of Harvard advanced trainers. Among those described are: a safety device for the protection of drop-hammer helpers; a roller machine for detaching burrs that result from drilling flat sheets; a new arrangement for skin assembly on a horizontal stabilizer; the replacement of thumbscrews with quick-acting toggle clamps for certain operations; the use of countersunk nut plates instead of countersinking the plate. Photographs illustrate the various devices and operations. *Canadian Aviation*, January, 1943, pages 39–43, 80, 13 illus.

The Production of "Power Eggs." Unit-type aircraft power plants comprising the engine and all accessories and connections are called "power eggs" in England, where particular attention has been given to this type of construction. A system of power installation has been perfected by British engineers which permits these self-contained power units to be assembled, removed, or replaced in a minimum of time. In this article the Alvis system of building installations for Rolls-Royce Merlin engines is described in considerable detail. It is explained that the work consists of

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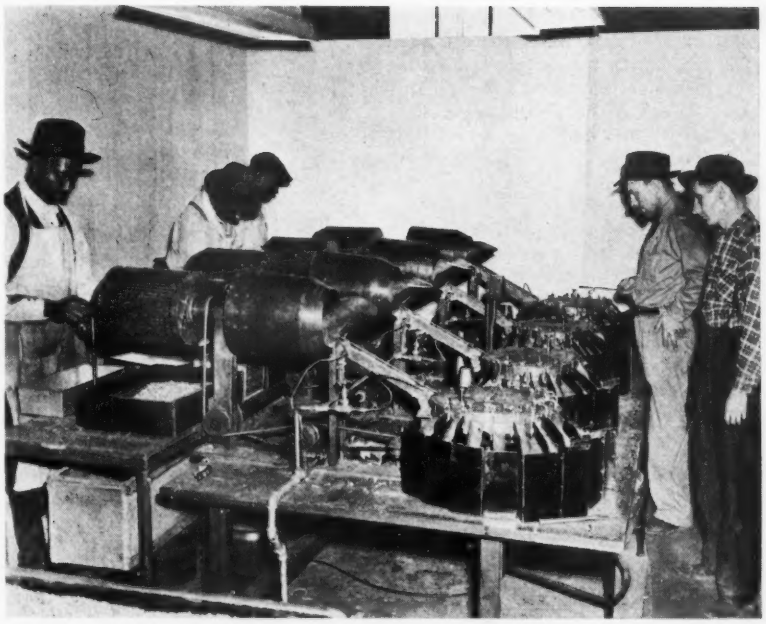
building the structure of the installation to the close limits necessary for the interchangeability of parts; erecting the engine in it, together with all components, subsidiary systems, and couplings for the services; and, finally, installing the cowling. *Aircraft Production*, January, 1943, pages 37–40, 10 illus.

Time vs. Space. Sidney Swirsky. First of two articles particularizing the problems of plant layout engineering in the aeronautical industry and telling how these problems are being solved. The assignment of space to assure the coordination of all plant operations and perfect assembly line timing is named as the goal toward which plant layout engineering is directed. Explaining the importance of this work, the writer also discusses common deterrents to it. *Western Flying*, January, 1943, pages 32, 33, 79, 80, 2 illus.

Producing Aircraft Parts at the Aluminum Mill. Michael H. Froelich. The operations of the Aircraft Parts Division of Reynolds Metals Company are surveyed. How the problems were approached and solved in view of the difficulties of priorities, allocations, material shortages, and other restrictions is related as a novel achievement. It is indicated that the company's business foresight has enabled the management to maintain control over considerable quantities of scrap metal. Transportation difficulties were also overcome by the elimination of hauling and cross hauling of both new and scrap materials between widely scattered aluminum and aircraft plants throughout the country. Other problems that were overcome include provision for the rapid expansion that was required in this definition, the acquisition of machinery, and training of personnel. *Aero Digest*, January, 1943, pages 104, 109, 110, 113, 114, 13 illus.

Drop-Stamping. Following an outline of the problems connected with the economical production of sheet-metal aircraft parts of complicated form, the writer describes how the production of compound-curvature sheet-metal parts is carried out with the Cecostamp. It is noted that the process has been widely adopted in America. Parts manufactured with this drop-stamping hammer are illustrated. *Aircraft Production*, January, 1943, pages 6–9, 14 illus.

Good Tooling Simplifies Production of "Flying Fortresses." Boyd K. Bucey. The writer describes the development of improved tooling methods at Boeing Aircraft Company. He tells how correct tooling procedures not only result in speedier and more economical production but frequently reduce assembly time and facilitate the employment of unskilled labor. Two of the Boeing innovations that he specifically notes are the "Octopus"—a hydropunch that notches the circumferentials of the Flying Fortress for more rapid joining of the longitudinal stiffeners and an automatic spot welder. Photographs illustrate several others. A flow chart diagrams the tooling-department procedure at Boeing, showing the sequence of actions from original request to finished tool. *Aviation*, January, 1943, pages 107–111, 221, 10 illus.



To eliminate hand sorting, the Fisher Body Division of General Motors developed the rivet sorting machine pictured here. The revolving cylinders at the far left sort the rivets according to thickness. Then they are placed in the hoppers at the center of the machine, from which they slide individually down to the rotating disc-like selector at the right. This selector first sorts them according to head type and then separates them by length. (*See* "From the Industry.")

Grundgesetze der Fertigung und ihr Einfluss auf die Gestaltung von Bauelement und Flugzeugtyp (Principles of Manufacturing and their Effect on the Shape of Airplane Parts and Airplane Types). E. J. Ritter. The plant manager of the Junkers Works presents the latest developments in airplane construction. He emphasizes the cooperation of designer and plant manager, stating that the designer should be sensible enough not to screen his ideas behind theoretic formulas and mathematical equations but should talk matters over with the plant manager, who represents the practical point of view. The writer indorses quantity production but calls attention to the fact that the proper construction method for metal wings is a most difficult problem. The interchangeability of parts is indicated as an outstanding advantage. *Schweizer Aero-Revue Suisse*, September, 1942, pages 355, 356, 361, 10 illus.

Solving New Production Problems on Standard Automatic Machines. H. L. Pope. Improved methods of milling and shaving splines in propeller shafts and long and short sleeve cranks are discussed, with particular reference to the accomplishment of desired results by the adaptation of standard machines instead of building special units. A detailed description is given of the process and equipment use for milling and shaving propeller-shaft splines, compared with the operation as previously performed. It is shown that the problem was solved by the use of fixed-bed milling machines with automatic table and spindle carrier movements. The fixtures used and the cycle of operation are similarly described for the rough and finish milling and shaving of long and short crank sleeve splines. *Aero Digest*, January, 1943, pages 176, 179, 180, 7 illus.

The Reynolds Plan for Parts. It is claimed that the advantages of fabricating parts at the source of material are illustrated by the Reynolds Metals Company's method of supplying prefabricated aluminum parts to the U.S. Army aircraft plant operated by the Douglas Aircraft Company, Inc., at Tulsa, Okla. This plan is said to eliminate a large volume of aluminum scrap, reduce shipping requirements, and release aircraft factories for other production purposes. *Southern Flight*, January, 1943, pages 42–45, 11 illus.

More From Your Drop Hammers. Chris J. Frey and Stanley S. Kogut. The concluding article in a series on drop-hammer technique and innovations describes the procedure in setting up the die and gives additional information on the making of dies and the uses of rubber. Detailed instructions are given for setting the punch and placing the dies, using clay dams to facilitate removal of the die when the time comes. An alternate method using clamping lugs is described. The discussion then turns to the two distinct uses of rubber in drop-hammer work: one for draw rings to restrain the sheet and the other as a means to localize the blow on any desired area. The types of rubber stock used and the properties and dimensions are covered. Details are also given on making the punch and the materials to be employed. The article concludes with remarks on the value of drop hammers in aircraft production. *Aviation*, January, 1943, pages 143, 145, 147, 149, 351, 7 illus.

How Cadillac Mass-Produces Allison Engine Parts to Close Tolerances. In a review of the adaptation of the precision-manufacturing facilities of the Cadillac division of General Motors to the production of parts for the Allison engine, the process of making rotor vanes for the supercharger is one of the operations featured. Present processes are contrasted with older methods; it was shown that existing machines had to be modified and entirely new machines had to be created to meet the exacting requirements of aircraft work. Another task entrusted to Cadillac was the making of crankshafts to withstand the increasing power of the later models of this engine. Detailed descriptions are given of the crankshaft-grinding and the camshaft and connecting-rod machine operations, as well as the machines that are used. Piston pins and complete reduction-gear assemblies are other parts being turned out by Cadillac. *Aero Digest*, January, 1943, pages 191, 192, 197, 198, 10 illus.

Propellers

Dynamics of Constant-Speed Propellers. Herbert K. Weiss. A theoretic investigation of the performance of constant-speed propeller controls, operating with various types of anticipatory components and several classes of lag, is undertaken over the performance range of the airplane. The effect of aerodynamic parameters of the propeller on the performance of the overall system is established. The advantage of nonlinear control characteristics is noted and demonstrated by calculation of control response for a typical combination of propeller, engine, control, and airplane. A number of charts are presented in dimensionless form, giving the propeller derivatives involved in control design. Charts showing stability requirements for a control system subject to both first- and second-order lag are supplied, as are charts for stability determination of control systems with constant time lag. *Journal of the Aeronautical Sciences*, February, 1943, pages 58–67, 70, 15 illus.

An American-built counterrotating, constant-speed propeller, a development of Hamilton Standard Propellers Division of United Aircraft Corporation, is shown on a plane at Rentschler Field, East Hartford, Conn. (*See* "From the Industry.")

One-Piece, Hollow Steel Propeller Blades. Joseph Geschelin. Production procedure in the manufacture of hollow steel propeller blades at the plant of the American Propeller Corporation is described. Starting with a hollow steel tube of large diameter, these blades are made in one piece. The writer traces the various fabricating operations. It is stated that throughout the various manufacturing stages the wall thickness of the tubing is maintained within rigid limits at all critical sections. It is noted that welding is held to a minimum and that seam welding is carried out with electric resistance-welding machines. The equipment of the plant is described. *Automotive and Aviation Industries*, January 15, 1943, pages 18–22, 70, 14 illus.

Radio

New UHF Landing System at La-Guardia. Information is furnished on the ultra-high-frequency landing system recently installed at La Guardia airport. Attention is drawn to the hazards and time lost in landing under unfavorable weather conditions when only the standard equipment of radio-range and flight navigation instruments are used. Reference is made to the fact that the Civil Aeronautics Authority has fostered the development of a suitable instrument-landing system utilizing ultra short radio waves that give both lateral and vertical guidance in addition to altitude fixes. Details of the new system are given. *Electronic Industries*, January, 1943, pages 62–64, 107, 108, 9 illus.

German Radio Equipment. This fourth installment of a series of articles on the radio equipment of German aircraft covers the standardized type of equipment installed in the later Ju 88 and He 111 airplanes. An extensive study of the receiving, transmitting, intercommunication, and direction-finding equipment and of the various circuits is presented. *Aircraft Engineering*, December, 1942, pages 342–357, 42 illus.

Radio and Fleet Aviation. Comdr. Frank Akers. Explaining the importance of radio to naval aviation, the writer stresses the fact that U.S. Fleet aircraft must be furnished not only with the best design of radio equipment but with personnel trained to make the best use of this vital equipment. The varied uses of radio for navigational, as well as communication, purposes are indicated. Com-

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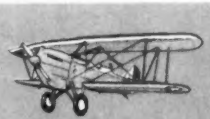

1927 • U. S. Army—A-3—An attack type powered by a Curtiss D-12 Engine. Designed specifically for ground strafing and low altitude bombing.

1932 • U. S. Army—A-8—An early low-wing monoplane type powered by a Curtiss Conquerer engine. Increased speed and heavy bomb capacity were improved characteristics.

1934 • U. S. Army—A-12—A Wright Cyclone furnished added power. Slots and flaps permitted low altitude maneuvers at slow speed. Machine guns in wheel fairings aimed downward.

1937 • U. S. Army—A-18—First twin-engined airplane (two Wright Cyclones) designed as attack-bomber. Bombs were carried internally. The nose housed four machine guns or a fast firing cannon.

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...the Axis won't print

Streaking from its base a squadron of Army Bell Airacobras heads for action... action that will bring forth another story of American bravery. Such a headline of heroism comes in the news from General MacArthur's Headquarters, Australia, of the award of the Silver Star to this Army Pilot for "gallantry in action:"

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Lt. Jemison was a member of a flight of Airacobras assigned to the task of strafing Lae, New Guinea, on May 4. When bad weather made it impossible for the whole formation to reach the target, Lt. Jemison attacked individually, destroying one enemy bomber grounded at the airdrome and badly damaging two others.

Headlines read at home and "shop talk" at battle fronts tell the same story: the Army Bell Airacobra is one of the world's most deadly fighters. Starting with a new conception of aerial striking power, the Airacobra was designed from the cannon bearing nose to the tail, specifically for the job. The job it is doing is headline news... news the Axis won't print. Victory will call for peace time planes produced by the same brilliant planning and sound engineering... but incomparably better because of the lessons learned in war. We are looking forward to that assignment. © Bell Aircraft Corporation, Buffalo, New York.

Airacobras for victory—

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BELL *Aircraft*

PACEMAKER OF AVIATION PROGRESS

ment is made upon the need for development of radio design to keep pace with new aircraft designs and other innovations brought about by war operations. *Flying*, February, 1943, pages 165, 166, 5 illus.

Rotating Wing Aircraft

The Shape of Ships to Come. Igor I. Sikorsky. In an interview reported by Alice Rogers Hager, Igor Sikorsky discusses the types of aircraft whose development he believes will be accomplished in the near future. Chief among these is the helicopter, the principles and operation of which he explains. The advantages he claims for the helicopter are elaborated. These consist of: simple operation and maintenance, safety, low cost when large production becomes effective, provision for the elimination of elaborate airports, maneuverability, power to stop quickly, and ability to hover. Admitting the speed limitations of rotating-wing aircraft, Mr. Sikorsky outlines the uses for which they are best adapted and states that they will be used extensively for personal and short-haul passenger transportation, especially when used with floats. However, he does not believe they will replace ordinary planes in commercial fields involving high speeds, heavy loads, and long distances.

In an examination of the trend of transoceanic clippers, it is contended that the flying boat will be more practical than the landplane in most cases. *Skyways*, February, 1943, pages 10–13, 74, 10 illus.

Stress Analysis

"Dynamic Stiffness and Effective Inertia Methods in Modern Torsional Vibration Theory." R. G. Manley. A discussion of the complex problem of determining the resonant frequencies of engine-propeller systems is presented, the intention being to unify scattered information on the subject. The writer defines stiffness and effective inertia and then indicates the application of the concepts to linear and damped systems. Confining further attention to undamped torsional motion, since in practice the effects of damping forces cannot be determined quantitatively, the problem of determining the natural frequencies is reduced to that of finding the frequencies for which certain quantities, which are functions of the dynamic constant, are zero. The writer describes methods of determining these quantities, including the practical method of measuring the dynamic stiffness of the propeller and methods of calculating the same quantity for engines with or without the complications of heavy shafts or gearing. Consideration then is given to tuning inertias and systems. In conclusion, a brief description is presented of five applications where the method has been found to be particularly effective. In an appendix the writer provides a proof of the theorem that the number of real distinct natural frequencies of a torsional system is equal to the number of degrees of vibrational freedom. *The Journal of The Royal Aeronautical Society*, January, 1943, pages 5–21, 8 illus.

Drawing Cylindrical Cups. E. L. Bartholomew, Jr. Results are presented of experiments conducted on stress-strain measurements of various metals that were drawn into cylindrical cups. The investigation was made because it has been stated that the suitability of a material to be drawn is in proportion to its ability to withstand and transmit strain. The writer feels that the tensile test, when properly interpreted, affords a satisfactory measure of this particular property. The results of the experiments indicate the significance of uniform strain and corresponding stress values. This article, which is the first of a series, includes a description of the materials investigated and of equipment and procedure. *Heat Treating and Forging*, January, 1943, pages 30, 31, 39, 4 illus.

"The Electro-Mechanical Analogy in Oscillation Theory." R. G. Manley. It is possible to represent a mechanical vibrating system—provided it includes no bending elements—by an equivalent electric circuit. Because the writer could find no description of the process of showing this analogy between vibrating mechanical systems and alternating current electric circuits, which lead to the concept of "mechanical impedance" (more correctly termed dynamic stiffness), he sets forth in this paper the principles underlying the procedure and illustrates them briefly by examples. *The Journal of The Royal Aeronautical Society*, January, 1943, pages 22–26, 9 illus.

An Investigation of the Behavior of Residual Stresses Under External Load and Their Effect on Safety. J. T. Norton and D. Rosenthal. Information is furnished on a basic investigation of residual stresses in welding carried out by means of new techniques. It is pointed out that the true role of residual stresses, especially those of high value, has not been established with certainty because of many factors involved in actual welding. *The Welding Journal*, February, 1943, pages 63-s–78-s, 24 illus.

Superchargers

The Hamilton-Whitfield Blower. A new positive-displacement type of blower is described as being suitable for use as a supercharger. The construction of the unit is detailed, with information on its particular features. *Automotive and Aviation Industries*, January 15, 1943, pages 44, 82, 2 illus.

Testing

Test Flight Stenographer. The purpose, construction, functioning, and operation of the Vultee Radio Recorder are explained. During a test flight this device records the various stresses and strains placed upon the airplane's parts and transmits them to the ground in split-second cycles. Such factors as flutter, vibrations, stresses, strains, temperatures, speed, and altitude are recorded and transmitted. One of the recorder's important features is that it helps to minimize the possibility of crashing planes during test flights because the engineers on the ground watching the plane's recorded behavior can warn the pilot should he fail to notice any dangerous conditions that may develop. *Western Flying*, January, 1943, pages 47, 96, 3 illus.

Tools and Equipment

Machine Tools Keeping the Pace. Tell Berna. Stressing the relationship and parallel production of the machine tool and aircraft industries, the writer explains why the former must be supplied with necessary man power and materials. Since the machine tool industry has learned to break down jobs into their component parts, the maintenance of sufficient supervisory personnel is indicated as its greatest labor difficulty. In the material allocation problem, the need for precision is pointed out as the important factor. *Aero Digest*, January, 1943, pages 163, 164, 166, 169, 6 illus.

Training

Canadian Machine Operators Learn by Doing. Albert Jude. The writer describes the way the aeronautical division of the Canadian Car & Foundry Company has combined training and production by utilizing inexperienced men and women employees and teaching them to produce precision-machined aircraft parts. It

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It just turns out that most of us working here at Packard Electric Division will never be with a landing party when it establishes a beach head, or take a tank into action across the desert, or have a crack at a Zero or Messerschmitt from the seat of an American fighter plane.

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is stated that even on complicated machines like turret lathes only one day's training is allotted. After seeing how the work is done, the trainee follows instructions step by step in the actual production of a simple piece. It is noted that trainees quickly learn the operations and acquire skill as they work. *Wings*, January, 1943, page 310, 4 illus.

Training the Luftwaffe. V. L. Gruberg. This article surveys the Luftwaffe's methods of obtaining and training its pilots and describes the training planes used by the German air force. It reviews the various phases of premilitary training, the succession of military flight courses, and the system of selection for commissioned ranks. Noting the influence of the Nazi Party upon Luftwaffe training procedure, the writer also indicates how the necessities of war have reduced the standards of both selection and training. Details are given on the Air War Academy and the qualifications of staff officers.

In the portion of the article covering training equipment, data are presented on specific planes employed for this purpose. It is stated that on the whole the Luftwaffe's training equipment is composed of old types so that the production capacity of the industry may be reserved mainly for operational aircraft. Simplification and easy exchange of parts are important considerations in determining what planes shall be used for training. Insufficient fuel is indicated as another problem influencing flight-training methods in Germany. *Flight*, December 10, 1942, pages 639–642, 7 illus.

Training Workers for Machine Tool Operation. John W. Busman. When the Briggs Manufacturing Company converted their production to bomber gun turrets the scarcity of experienced operators for specific types of machine tools necessitated an educational program for "on the job" training. This article describes the program, developed with the cooperation of Sperry Gyroscope Company, telling how competent instruction within the department enabled the utilization of machines for both production and training. It details definite procedures that were set up and perfected in milling, drilling, grinding, and gear cutting departments. The instruction of women is noted particularly and mention is made of courses that were added later. These consisted of training for instructors, inspectors, and job setters. Several photographs illustrate the types of machines and fixtures that are in use. *Aero Digest*, January, 1943, pages 116, 118, 120, 125, 254, 256, 9 illus.

The Cessa U.S. Army "Bobcat" trainer used for bomber-pilot training and to provide an intermediate step in the student's progress from single-engined craft to multiengined combat bombers. (*See* "From the Industry.")

Flight Training. Lt. John R. Hoyt. A study of the problems connected with the need for the rapid production of naval pilots and how these problems were met. The phases of training through which a naval aviation cadet passes until he is qualified for specialized flying and is then assigned to carrier, patrol, or observation-scouting squadrons are also outlined. A major portion of the article is devoted to a discussion of two basic solutions that were applied to the quantity production problem: one was the improvement of the Navy's methods of pilot preselection and the other was the increasing of instructor efficiency. *Flying*, February, 1943, pages 169–173, 275, 7 illus.

The Care of the Motor. The establishment and operations of the technical schools maintained for R.A.F. and Fleet Air Arm personnel by the Bristol Aeroplane Company with the cooperation of the Air Ministry are recounted. Five engine courses are given, covering the five types of Bristol engines which are in service in large numbers, the Pegasus, Mercury, Perseus, Taurus, and Hercules. Each syllabus is divided into two parts: the first in the exhibit room or classroom and the second in the shops. The equipment and the instruction are described. *The Aeroplane*, January 1, 1943, page 12, 3 illus.; "The Bristol Engine School," *Flight*, December 31, 1942, pages 721, 722, 3 illus.

Adel's Training System. George Tharratt. In this article the writer tells how the Adel Precision Products Corporation has established a training system under the direction of the engineering department which is solving the problem of obtaining adequate trained personnel. In addition to class instruction, the system provides shop and inspection methods considered best for the rapid and accurate production of the company's specialties, which include line supports, anti-icing systems, and hydraulic units. To assure the standardization of all procedures, a course of instruction for foremen and supervisors also is provided. Advice for supervisory personnel is summarized. *Automotive and Aviation Industries*, January 15, 1943, pages 30, 31, 80, 3 illus.

A Command is Born. The growth of the Flying Training Command from March 16, 1939, to the present is traced. He tells about the thousands of combat air crews which are today being turned out from the many United States training fields. *The American Pilot*, January, 1943, pages 10, 11, 2 illus.

Bristol Airframe School. A description of the Bristol Aeroplane Company's instructional course for air-frame maintenance. Already fully trained and qualified engineers, the pupils at the school come from R.A.F. operational stations employing Bristol aircraft. In addition to the courses on the specific air frames, there is also one for electricians on the electrical circuits of the aircraft and another for armorers, covering the construction, operation, and mainte-

nance of the power-operated Bristol turrets. *Flight*, December 24, 1942, pages 682, 683, 3 illus.

Training of Welding Foremen. F. H. Achard. Information is furnished on the training of welding foremen. The article discusses features of welding as an occupation and describes the characteristics that a welder should possess. Consideration is given to special features of the welding foreman's job and to the selection of welding foremen. He then takes up preappointment training, initial training after appointment, and continuation training. *The Welding Journal*, February, 1943, pages 113–115.

Training and Supervising the New Workers in the Aircraft Industry. E. W. Lloyd. An outline of the procedure for instructing new workers, as advised in the Canadian Department of Labor's training course for foremen and supervisors. Step one is to explain the job to the worker and put him at ease; step two, to teach him the job by actual demonstration as well as verbal instruction; step three, to watch him as he works, correcting any errors before they are repeated; and step four, to put him on his own responsibility, gradually decreasing the amount of supervision over his work. *Canadian Aviation*, January, 1943, pages 76, 78, 1 illus.

Split Seconds Spell Superiority. Brig. Gen. Luther S. Smith. With a demonstration of what it accomplishes, the purpose of the Army Air Forces physical training program is explained. Applying equally to air and ground crew, the program requires physical training for all air forces personnel below the rank of Colonel. In the physical conditioning of air crews, exercises are provided which correct any deficiencies and develop a maximum physical efficiency for each job. As a cadet advances from preflight training to elementary, basic, and advanced schools, he spends less time on hardening and conditioning exercises and more time on mass sports. The article names different types of gymnastics and sports which are incorporated in the program. *Skyways*, February, 1943, pages 22, 23, 75, 5 illus.

Selection Board. Joseph B. Lynch. A brief account of how naval aviation trainees were selected by the Naval Aviation Cadet Selection Boards until recruiting ceased, with some indication of how their experience will be utilized under the War Manpower Commission. Criteria for selecting cadets are noted and credit is given to the civilian organizations that assisted the 15 boards in their recruiting task. *Flying*, February, 1943, page 178, 2 illus.

Flying Training Command Gives America's Army Wings. This article describes how the Flying Training Command of the Army Air Forces is turning out thousands of skilled airmen from airfields all over America.

Six points are outlined by which superiority is being gained in airplanes, equipment, personnel, experience, and armament. *The American Pilot*, January, 1943, pages 18, 19, 7 illus.

War Birds Must be Flyers. Bert Hall. A veteran of the original Lafayette Escadrille contends that modern flight-training methods turn out operators and not fliers. Claiming that present-day pilots are too dependent upon their controls and instruments and not enough upon their own ability, he describes the French roller system of pilot training employed during the World War I period. From start to front-line squadron this method provided the student with about 50 hours of training, mostly in the air and by himself. But it produced, the writer states, pilots with self-confidence and self-

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reliance. Details are included on early types of Farman and Bleriot planes in which the writer learned to fly. *Southern Flight*, January, 1943, pages 24–26, 39, 53, 4 illus.

Training Films. Lt. Thomas Orchard. An article on the value of motion pictures in facilitating naval aviation training. It is shown how the training film unit of the photographic section, Bureau of Aeronautics, provides a means of teaching highly technical subjects in a minimum of time. The requirements for effective training films and the problems connected with making them are examined. With instruction in amphibious warfare as an example, it is stated that motion pictures are proving useful in three ways: they are helping to cut down the time needed to train men; they are enabling experts to study the maneuvers as a whole and improve tactical methods; and they are establishing better liaison between the branches of the armed services because they enable each one to study the function and operation of the other. The contributions of technical experts, educators, and production men in making these films are demonstrated. *Flying*, February, 1943, pages 179, 180, 272, 275, 4 illus.

"Seek the Unusual in the Air." Capt. Norman MacMillan. In this article the writer advises the pilot to seek unusual conditions in the air as a means of broadening his experience and learning to meet the unexpected. He stresses the importance of learning meteorology before actual flying is started. *Canadian Air Cadet*, January, 1943, pages 10, 22, 23, 2 illus.

Making Youngsters Airminded. Robert W. Hambrook. An outline of preinduction aviation studies that are being incorporated into the curricula of American elementary and high schools. Although in preparation for aeronautical careers, scholastic emphasis in primary and secondary schools is upon mathematics, physics, and physical fitness; courses are also being given in aerodynamics, aircraft structures, types of military aircraft, recognition of aircraft, principles of aircraft engines, types of power plants, elements of meteorology, air navigation, and communications. For high-school students there is available now a wide range of texts dealing with many angles of aviation. They set forth the fundamentals of flight theory, internal-combustion engines, materials and construction of aircraft, types of aircraft and aircraft engines, meteorology, and air navigation among others. *Skyways*, February, 1943, pages 38, 39, 48, 9 illus.

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

Warfare

Maltese Falcons. Flight Comdr. F. H. E. Hopkins. An account of the living and fighting conditions of a British air squadron on Malta. The importance of the island's position for torpedoing Axis shipping is stressed. *Skyways*, February, 1943, pages 42–45, 79, 15 illus.

Will Precision Bombing Win the War. Keith Ayling. The writer presents a general outline of bombing operations and technique. He believes precision bombing will be the most important factor in the winning of the war. Emphasis is placed on the value of American methods of precision bombing, which are described. *Air Life*, March, 1943, pages 22–25, 46, 47, 15 illus.

Der Landungsversuch bei Dieppe (The Commando Raid at Dieppe). Based on official British and German reports, the article analyzes the part played by the Allied and German air units in this raid. It is stated that the inability of the Allied air forces to give the invading troops the proper support against the opposing ground troops and the ability of the Germans to concentrate within a short time air units that had been spread out along the entire Channel coast decided the issue. *Schweizer Aero-Revue Suisse*, September, 1942, pages 363–365.

Tales of the "Vacuum Cleaner Room." Samuel T. Williamson. Several heroic episodes are related to illustrate the types of stories that are reported to examining officers in "Room 7893A," Washington, D.C. In that office airmen of the U.S. Army, Navy, and Marines who have just returned from active combat duty answer questions about their ideas on training, air tactics and strategy, airplane design and equipment, etc. The exploits described in this article tend to dispel some popular superstitions about Japanese airmen . . . . their suicidal tendencies, self-sacrifice, and daring. *Air Facts*, February 1, 1943, pages 7–14.

Mitchell Battle Log of the B-25. A summary of the B-25's combat record. Brief paragraphs in chronologic order review this medium bomber's part in military action from February 5, 1942, to November 18, 1942. *Western Flying*, January, 1943, pages 44, 45, 80, 1 illus.

Gas Attacks Need Not Scare Us. Hal White. Consideration is given to whether or not gas will be used in this war. It is noted that some have predicted that when the Germans have been goaded to desperation, they will resort to this form of warfare. The writer believes that while gas could have been used successfully by Germany in the early part of the war when England was under heavy air attack and could not retaliate, the time for its effective employment now has passed. The various kinds of war gases are described and their relative effectiveness is discussed. Methods of gas attack are outlined. *Air Life*, March, 1943, pages 34, 35, 48, 49, 7 illus.

Flugzeuge als Feinde der Panzerwagen (Airplanes as the Conquerors of Tanks). Ernst Wyss. A technical study of the modern tank battle and the tactical use of airplanes against tanks. Tanks are said to be vulnerable on the top and in the rear while the front and the sides are heavily armored. Therefore, the airplane, more than any other weapon, has the best chance to put tanks out of action. The writer, an officer in the Swiss army, discusses the armament with which this may be accomplished. *Schweizer Aero-Revue Suisse*, September, 1942, pages 366, 367.

Welding

Factors to Consider in the Choice of Welding Plant. Eric F. Gilson. Emphasis is placed on the importance of using care in the selection of welding equipment. The necessity of obtaining a current supply with the required voltage-ampere characteristics is stressed. The writer explains that the voltage should instantaneously adjust itself to the arc. Difficulties encountered with the use of a constant voltage supply are outlined. It is pointed out that the usual custom is to employ a motor- or engine-driven generator especially designed to overcome these difficulties. Problems connected with single-operator sets and multioperator systems are discussed. *Sheet Metal Industries*, January, 1943, page 137.

Radiographic Inspection Technique Applied to Special Welding Problems. Don M. McCutcheon. The estab-

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lishment of good X-ray inspection technique on welded sections involves many problems that are treated in this discussion. Consideration is given to the inspection of welded sections ranging from heavy armor plate to thin aluminum spot welds. It is emphasized that special precautions are required in the X-ray examination of welds in complicated sections of aluminum castings. Information is furnished on the repair welding of aircraft-engine aluminum cylinder heads. It is brought out that in the radiographic examination of aluminum spot welds a technique is required which will insure resolution on the X-ray film of the smallest defect that is considered necessary for the proper performance of the parts. *The Welding Journal*, January, 1943, pages 16–20, 18 illus.

Spot-Welding Light Alloys. A survey is presented of modern spot-welding practice in aircraft factories. The article deals with the resistance-welding process as applied to the fabrication of light-alloy aircraft secondary structures. Reference is made to recent improvements in spot-welding machines. Difficulties first experienced in the attempt to weld alloys of aluminum and magnesium are described. How these difficulties were overcome by the development of special a.c. and d.c. welding equipment is explained. Information is furnished on the Sciaky electric resistance-welding machine. Basic requirements for the satisfactory spot welding of aluminum alloys are enumerated, and the spot-welding technique is discussed. *Aircraft Production*, January, 1943, pages 3–5, 4 illus.

Designing for Production Welding. H. A. Oldenkamp. Discussing methods for faster production, this article emphasizes the importance of attention to weld costs and speeds. The necessity of actually calculating the sizes and lengths of welds to do certain jobs is stressed. It is explained that too much weld on a drawing results in wasted material and unnecessary labor. How the amount of welding on a motor mounting base was reduced 28 per cent by going over the design is described. *The Welding Journal*, January, 1943, pages 24–31, 7 illus.

Examination of Stress Distribution in Spot Welded Joints in Light Alloys by Means of the Brittle Lacquer Process. R. F. Tylecote. In this paper the writer describes the brittle-lacquer process for the determination of stresses in spot welds and investigates its advantages. The process was largely developed by the Maybach firm in Germany. It is noted that processes for strain meas-

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urements so far used extensively are all relatively slow and require a considerable amount of preliminary knowledge. Advantages of the brittle-lacquer process over the photoelastic process are set forth. It is stated that the brittle-lacquer process can be readily applied to full-scale structures and obviates the inaccuracies and difficulties of interpretation associated with models. *The Institute of Welding Quarterly Transactions*, July, 1942, pages 120–132, 25 illus.

Electron Tube Control of Resistance Welding Machines. B. G. Higgins. This is the second of a series of articles in which fundamental principles of electron tube control for resistance-welding machines are set forth. The writer continues a discussion of the resistance-capacity timing circuit and contact timer control. A technical description of the circuit is furnished and the principle of heat control by phase shift is outlined. The type FW224L2 ignition spot-welder control equipment then is discussed, the circuit operation being described. *Sheet Metal Industries*, January, 1943, pages 138–144, 146, 13 illus.

The Effect of Sodium and Potassium Silicates on the Properties of Weld Metal. G. Haim and D. McAllister. This paper reports the results of a study covering the use of solutions of potassium and sodium silicates as binding agents in arc welding electrodes. The study was conducted because available literature on the subject was limited, and some results obtained by the writers conflicted with conclusions reached by other investigators. The writers describe tests carried out with five different types of silicate solutions and their mixtures to determine the characteristic properties of electrodes made with varying proportions of sodium and potassium silicates. The results of these tests are summarized. *The Institute of Welding Quarterly Transactions*, July, 1942, pages 133–135.

Spot Welding in Aircraft Structures. E. S. Jenkins. The comparative strength and efficiency of spot welds and rivets is investigated. It is stated that the use of spot welding in aircraft construction can be greatly extended. The writer points out that in general spot welding has been confined to secondary structures where failure will not seriously endanger the performance of the airplane. He contends that much of the riveting used in the fabrication of sheet stringer skins, which consist of thin sheets stiffened by attached stringers, can be replaced by spot welding. Information is furnished on the time saved and other advantages gained with the use of spot welding. *The Welding Journal*, December, 1942, pages 839–843, 9 illus.

Welding with Aluminum Bronze. C. E. Swift. The development of aluminum-base alloys is discussed with particular reference to welding with aluminum bronze. The advantages of aluminum-bronze electrodes over copper-alloy and bronze welding rods are outlined. Applications for coated aluminum-bronze welding rods are described. *The Welding Journal*, December, 1942, pages 843–845, 5 illus.

Welded-Steel Tubing and Its Applications in War Production. H. S. Card. The writer describes what welded-steel tube is and how it is used. He explains that because practically all the output of tube welding mills in the United States has been absorbed by a small group of industries, information on welded-steel tubing has reached only a few engineers. How welded steel tubing is being manufactured with modern welding equipment is described. Applications of welded-steel tubing are enumerated. Aircraft parts where welded tubing may be used include the fuselage, engine mounts, landing gear, seat frames, and mounts for motors and pumps. *The Welding Journal*, December, 1942, pages 846–851, 12 illus.

Wind Tunnels

On the Design of the Contraction Cone for a Wind Tunnel. Hsue-Shen Tsien. Problems involved in the design of the contraction cone by the use of the hydrodynamics of compressible fluids and of a cone for incompressible flow are formulated. Consideration is given to the effects of local velocities resulting in adverse pressure gradient and the possible separation of the boundary layer from the wall. An explanation is offered of the way this danger can be avoided. After a statement on the formulation of the problem, a solution is presented mathematically by which the stream lines and velocity profiles are plotted. It is shown that one of these stream lines can be used as the shape of the contraction cone, but modifications for different cross sections of the cone are found to call for the selection of another of the stream lines for the final recommended shape of the cone. *Journal of the Aeronautical Sciences*, February, 1943, pages 68–70, 3 illus.

Miscellaneous

Night Bombing and the People. Tom Harrisson. Information is furnished on the psychologic effects of night bombing as revealed by the technique of social study through random samples. The behavior and mental reactions of civilians occupying different types of air-raid shelters are described. A diagram is furnished showing the percentage of sleep obtained by London inhabitants (according to mass observation) during the heavy air raids in the winter of 1940. *Aeronautics*, December, 1942, pages 28–30.

The French Aircraft Industry Today. Lucien Zacharoff. The writer presents an account based on available facts of French collaboration with Hitler and its effect on the French aircraft industry. Considerable information is furnished on the nature and extent of the aircraft equipment France is now producing for Germany. *Air Progress*, January, 1943, pages 2–4, 49, 50, 5 illus.

Theory and Technique of Perspective Projection. George F. Bush. Part I of a series of articles on graphic projection fundamentals deals with the theory and application of one-point, or parallel, perspective. With the superiority of the latter established for the general case, two methods of construction are explained: one, the "piercing point" method; the other, the "vanishing point" method. The article also tells of the advantages of perspective engineering illustrations over ordinary blueprints and drawings. *Aviation*, January, 1943, pages 118–120, 125, 349, 8 illus.

Crating the P-40 For Export Shipment. Supplemented by details of the equipment used, methods of packing Curtiss-Wright fighter aircraft for shipment to foreign countries are described. Particulars are given on shipping-box specifications, anchoring and securing procedures, protection devices, mounting and placement of subassemblies and boxes, the use of padding, method of waterproofing, etc. Two boxes are used for each plane, one for the wing panel and the other for the fuselage. Bolts, lag screws, and metal bands help to secure the equipment and prevent damage to the parts caused by shifting. *Aero Digest*, January, 1943, pages 222, 224, 227, 314–316, 6 illus.

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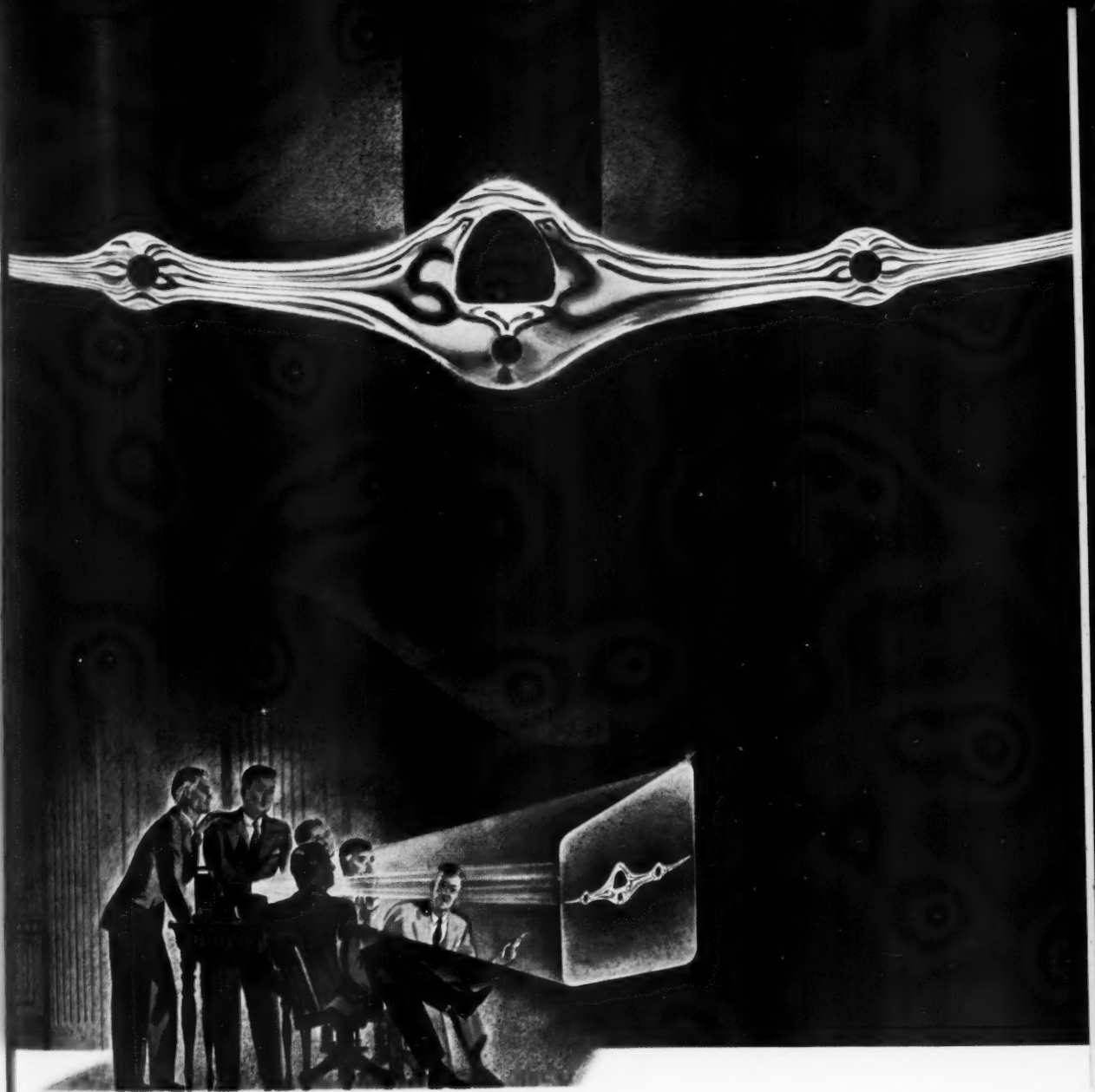

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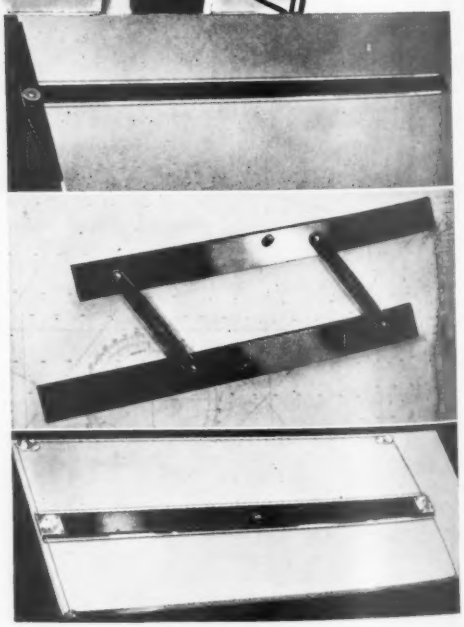

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Foreign Aircraft—Some Technical Aspects. Lt. Col. J. M. Hayward. Important characteristics of some well-known foreign combat planes are presented and an analysis of the relative technical values of these aircraft is made. It is noted that early reports on certain foreign aircraft minimizing their equipment or attributing extraordinary performance and armament to them have not been established by fact, while the boasted superiority of speed, high-operating altitude, and fire power claimed for some enemy aircraft have been largely disproved by experience. Consideration is given to German, Italian, and Japanese combat planes, and some performance data on combat planes of the Allied Nations is presented. *Air Force*, January, 1943.

How to Keep Well in the Alaskan Theater. Brig. Gen. David N. W. Grant. In the second of a series of articles on health conditions in various war theaters of operation, the Air Surgeon explains that the cold climate of Alaska influences every act of life from early fall to late spring and describes how topography and climate account for local variations in living conditions. He warns against wearing a beard because the moisture of the breath accumulates on it and freezes. The importance of strictly sanitary discipline is emphasized. It is stated that the exhaust pipe of a vehicle stalled in the snow with the engine running may become clogged up and cause carbon monoxide to fill the interior with consequent danger to the occupants. Information is furnished on how to avoid frostbite. *Air Force*, January, 1943.

Organization of the Army Air Forces. Col. Byrone E. Gates. The Assistant Chief of the Air Staff, Management Control, reviews the growth of the U.S. Army Air Forces and draws a picture of the present structure of this branch of the Army. He tells how the experience of modern warfare necessitated a drastic reorganization of the War Department and the Army in the interests of greater combat efficiency. A large chart detailing the organization of the Army Air Forces is presented. *Air Force*, February, 1943.

The Other North African Battle. Information is presented on weather conditions in various sections of the North African theater of the war with particular reference to military air operations. Consideration is given to temperature variations, barometric changes, air currents, clouds, and rainfall. *Air Force*, January, 1943.

Guides for Global War. Capt. F. I. Burnham. In this first of a series of articles the writer stresses the importance of maps and charts in the execution of military operations and presents a brief historical outline of cartography. He then considers the classification of maps, which he states may be divided into two main groups: namely, general purpose maps and special purpose maps. Both groups are discussed. Reference is made to services performed by the Weather Bureau, which include the supplying of maps for marine and aerial navigation. The forthcoming installment will cover military maps. *Air Force*, February, 1943.

How to Keep Well in the Southwest Pacific Theater. Brig. Gen. David N. W. Grant. This is the first of a series of articles on health conditions in war theaters of operation. The Air Surgeon discusses health hazards to which troops are subjected in the East Indian archipelago and nearby islands and furnishes advice on how to avoid infection. Attention is drawn to the danger from mosquito-borne diseases, which include malaria, dengue or "breakbone fever," and filariasis. Preventive measures against the mosquito are discussed. The importance of wearing nets and extra clothing is emphasized. It is explained that the bite of disease-carrying mosquitos frequently does not sting and that such mosquitos often do not appear until night. Native villages where mosquitos are usually more prevalent should be avoided. Suppressive prophylactic treatment is discussed with particular reference to quinine and atabrine for malaria. Information is furnished on the use of sulfaguanidine in the treatment of dysentary. The need for sanitary precautions in this area is stressed. *Air Force*, February, 1943.

Three-Dimension View of the Enemy. Capt. L. B. Wright. The writer describes the value of aerial photography in military observation. Advances in three-dimensional photography technique are outlined. It is explained that modern photographs furnish a true visual record of the terrain over which the plane has flown and make it possible to determine the size of troop concentrations, the direction of troop movements, and the quantity of supplies possessed by the enemy. *Air Force*, February, 1943.

We Keep 'em Firing. Major J. B. Morris. Target work carried out by the Army Air Forces at Ellington Field, Tex., is described. New target-towing techniques provide simulated combat conditions for gunnery and antiaircraft personnel. *Air Force*, February, 1943.

Here Come the Airborne Troops. Brig. Gen. Fred S. Borum. Maneuvers of the Troop Carrier Command of the Army Air Forces held in Texas last fall are described. It is explained that this preview of America's air-borne strength was the first of its kind ever held by the U. S. Army. The writer tells how this country is applying the science of transporting men, weapons, and supplies by air. *Air Force*, February, 1943.

National Advisory Committee for Aeronautics

Aerodynamics of the Fuselage. H. Multhopp. Translation of an article "Zur Aerodynamik des Flugzeugrumpfes," from *Luftfahrtforschung*, Vol. 18, Nos. 2–3, March 29, 1941, pages 52–56. This report deals with a number of problems, particularly with the interaction of the fuselage with the wing and tail, on the basis of simple calculating methods derived from greatly idealized concepts.

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flow, which, similar to the lift of a wing of small aspect ratio, is no longer linearly related to the angle of attack. Nevertheless, there exists for this frictional life something like a neutral stability point the position of which on oblong fuselages appears to be associated with the lift increase of the fuselage in proximity to the zero lift, according to the present experiments.

The pitching moments of the fuselage can be determined with comparatively great reliability as far as the flow conditions in the neighborhood of the axis of the fuselage can be approximated if the fuselage were absent, which, in general, is not difficult.

For the unstable contribution of the fuselage to the static longitudinal stability of the airplane it affords comparatively simple formulas, the evaluation of which offers little difficulty. On the engine nacelles there is, in addition, a substantial wing-moment contribution induced by the nonuniform distribution of the transverse displacement flow of the nacelle along the wing chord; this also can be represented by a simple formula. A check on a large number of dissimilar aircraft types regarding the unstable fuselage and nacelle moments disclosed an agreement with the wind-tunnel tests which should be sufficient for practical requirements. The errors remained throughout within the scope of instrumental accuracy.

For the determination of the fuselage effect on the lift distribution of the wing the flow transverse to the fuselage was assumed to be two-dimensional; then all the mathematical difficulties that the fuselage of itself would entail can be removed by a conformal transformation of the fuselage cross section to a vertical slit. Then the calculation of the lift distribution for a wing-fuselage combination reduces to that of an equivalent wing, wherein the fuselage effect is represented by a change in chord distribution and also, to some extent, in the angle-of-attack distribution. Then the conventional methods of computing the lift distribution of a wing are fully applicable. In particular, it again affords two basic distributions from which the lift distributions for the different c_a values of the wing can be found by linear combination, as is customary on a wing without fuselage effect. The portion of lift taken over by the fuselage itself is easily estimated from the lift distribution so determined. The air load distributions determined for the wing-fuselage combination by this method differ considerably from those obtained by the orthodox

method when the measured c_a differences were directly distributed as positive or negative fuselage lift across the fuselage width.

In the case of sideslip, the displacement flow of the fuselage causes an additional antisymmetric life distribution along the wing (for a high- or low-wing arrangement) with an attendant rolling moment of considerable magnitude. The simple formula evolved for this rolling moment on elliptical fuselage sections is satisfactorily confirmed by the few available measurements.

With regard to the effect of the fuselage on the flow conditions at the tail surfaces, the sideslip of the fuselage for a high- or low-wing arrangement produces a side-wash at the vertical fin and rudder and leads to appreciable changes in directional stability and damping in yaw.

A few measurements demonstrating this phenomenon distinctly are intended to rivet attention to the results of this phenomenon in the mechanics of unsymmetric flight motions. *N.A.C.A. T.M. No. 1036*, December, 1942.

The Performance of a Vaneless Diffuser Fan. V. Polikovsky and M. Nevelson. Translation of Report No. 224, of the Central Aeroy-Hydrodynamical Institute, Moscow, 1935. This paper is devoted to the theoretic and experimental investigation of one of the stationary elements of a fan—namely, the vaneless diffuser. The method of computation is based on the principles developed by Pfleiderer (Forschungsarbeiten No. 295). The practical interest of this investigation arises from the fact that the design of the fan guide elements—vaneless diffusers, guide vanes, spiral casing—is far behind the design of the impeller with regard to accuracy and reliability. The computations conducted by the method here presented have shown sufficiently good agreement with the experimental data and indicate the limits within which the values of the coefficient of friction lie. *N.A.C.A. T. M. No. 1038*, December, 1942.

Pressure Distribution in Nonuniform Two-Dimensional Flow. M. Schwave. Translation of an article titled "Über Druckermittlung in der nichtstationären ebenen Strömung," from *Ingenieur-Archiv*, Vol. VI, No. 1, February, 1935, pages 34–50. The two-dimensional flow past a circular cylinder is made visible on the surface of water by scattered particles and recorded under long exposure by a motion-picture camera. The velocity of flow is deduced from the path lengths of the particles, the radius of curvature of the paths is defined, the pressure along a stream line is determined according to Bernoulli's general formula and transverse to the stream lines according to the centrifugal force formula. The pressure distribution formulas for different stages of development of the vortex pair and for one state of the vortex street are indicated, the pressure field is determined, the pressure drop behind the cylinder is analyzed, and the variation of the pressure drag coefficient with respect to time is demonstrated. It reaches a value about twice as high as in the steady state. The asymmetric pressure distribution on the cylinder is demonstrated for one stage of development of the vortex street and the force transverse to the flow direction defined; it amounts to more than 40 per cent of the drag in this instance.

In the theoretic treatment the customary potential flow is superposed by a source-sink flow, the potential of which is secured by series development, from which the velocity components are deduced. In the pressure formula the time variable and its derivation are solved from the recorded motion of the free stagnation point.

A comparison of theory and experiment indicates good agreement in the stream-line pattern. The approximation of the theoretic to the experimental pressure distribution on the zero stream line for an early state of development of the vortex pair is also satisfactory. Subsequent calculation indicates pronounced departures from the test data. The theoretic pressure field is compared with the experimental, the theoretic pressure curve on the line of symmetry behind the free stagnation point, and the pressure drop in it dependent on the time is obtained in satisfactory approximation with the test data. *N.A.C.A. T.M. No. 1039*, January, 1943.

Civil Aeronautics Board

Civil Air Regulations. Amended sections of the Civil Air Regulations have been issued as follows: Part 01—Airworthiness Certificates; Part 21—Airline Transport Pilot Rating; Part 24—Mechanic Certificates; Part 40—Air Carrier Operating Certification; Part 52—Repair Station Rating; Part 61—Scheduled Air Carrier Rules; Part 98—Definitions.

War Production Board

Controlled Materials Plan Class B Products List. This list has been issued for the use of manufacturers operating under the C.M.P. It includes some 500 groups of related items classified as B products and will be used by manufacturers to determine whether they are Class A or Class B producers. It is explained that only those products containing controlled materials that are included in the official list are Class B products. All other products containing controlled materials are, by definition, Class A products.

Under the C.M.P., manufacturers of A products will receive their allotments of materials from the Claimant Agency or agencies under whose programs they are operating. B producers, on the other hand, will receive their allotments from the appropriate Industry Divisions of the War Production Board.

British Information Services

"Toys" That Safeguard Britain's Convoys. George Mawson. An article that relates what the seagoing balloon has done for Britain's merchant vessels. It tells how a large balloon is attached to the stern of each freighter in a convoy by a steel cable for the primary purpose of keeping enemy bombers high and preventing them from diving low to release their bombs. The cable also bars the bombers' favorite approach to the ship, which is up-wind from aft. *Britain*, February, 1943.

French Secretary of State for Aviation

Recherches Expérimentales Concernant le Givrage des Avions (Experimental Research Regarding Ice Formation on Airplanes). Edmond Brun. This bulletin gives reports on laboratory and wind-tunnel tests on ice formation on airplane propellers and on the application of ice-prevention devices and also tests on special heatable glass to be used on airplanes. The writer points out that flight tests would give more accurate results but that this method is rather dangerous for the airmen engaged in the experiments and would take up too much time due to the mild climate of France. Therefore, these experiments were made under conditions closely resembling those met during flight. Observations during flight are to be used as a means to check the experimental results. This report describes the various procedures applied to create ice and to investigate the relations between the structure of the ice and its formation. These relations, as a whole, correspond with such observations as have so far been made during flight. *Publications Scientifiques et Techniques du Secrétariat d'Etat a l'Aviation*, No. 98, 1941.

Paved with Good INVENTIONS

Application of fundamental discoveries in science, the *development of inventions* into practical devices, presents challenging problems to the Electronic Industries.

Inspired theoretical analyses of men like Henry, Faraday and Maxwell; inventions of others like Marconi, de Forest and Armstrong —these are the fundamental ideas of modern communications and electronics.

Working with these ideas, electronic engineers have progressed brilliantly over a part of the long, winding road from scientific discovery to a fast-growing industry serving millions of people.

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Though we may not be able right now to supply you with the Resistors you need for other than war uses, our engineers and executives are at your service for counsel, without obligation, to help you in the solution of Resistor problems. Please feel free to consult them in your search for the best obtainable resistance devices under existing conditions.

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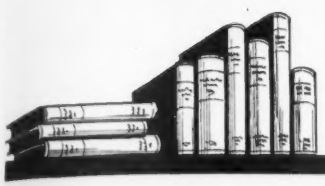
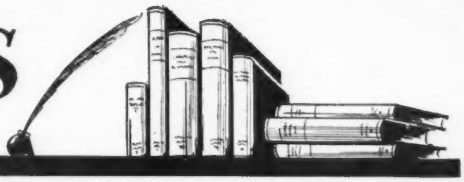


BOOKS



Books reviewed in this section may be borrowed without charge from The Paul Kollsman Library, Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York, N. Y.

Airport Fundamentals

This is one of the "Air-Age Education Series" for the air indoctrination program of the high schools. In brief outline it provides information about all phases of the airport . . . its development, its lights and their meanings, facts about traffic control in the air. It describes radio-traffic control, explains the functions of an airport meteorologist, and tells how planes are loaded. The important questions of whether travel by air is safe and whether the nation's airports are adequate for growing aviation needs are answered also. It is suggested that, in addition to providing a source of information, the contents of this book are particularly valuable for supplementary work in history, English, and science classes.

The Airport, by Charles K. Arey; The Macmillan Company, New York, 1943; 35 pages, $0.40.

Jet Propulsion Systems

This book is said to be the first devoted entirely to aircraft propulsion plants employing combustion gas turbine and axial compressor combinations. In addition to gas turbines, some information is furnished on steam turbine designs. The latter part of the book is devoted to turbine units driving orthodox airscrews, the development of which is believed by the author to offer great future possibilities. Much of the information contained in the book was originally published in *Flight.* Following a brief historical outline of early mechanical ideas regarding jet propulsion, the writer presents chapters covering jet propulsion for aircraft, aircraft units employing rotary or reciprocating compressors, and the thermal jet principles and its influence on design. The potential advantages of jet propulsion are summarized and compressorless schemes are discussed. The first recorded flights of the Caproni-Campini jet-propelled aircraft, the mechanical details of which were given in an earlier chapter, are described. As a prelude to the discussion of the subject of gas turbines for airscrew propulsion, the author describes the limitations of the reciprocating engine and outlines the possibilities of the gas turbine.

Gas Turbines and Jet Propulsion for Aircraft, by G. Geoffrey Smith; Flight Publishing Company, Ltd., London, England, 1942; 56 pages, 3*s.* 6*d.*

Strategic Territory

No part of the United States is receiving such intensive study as Alaska. Its strategic location in the new air age gives it a new significance. There are answers to the question why Alaska holds so much strategic value that Gen. "Billy" Mitchell is credited with having said that Alaska is the most central place in the world for aircraft and the most important place in the world. What is going on there and what the people are like are told in a way that will interest both adults and young people. The chapter on the Aleutian Islands and other strategic islands off the coast is especially timely.

An experienced photographer assembled the remarkably interesting views and asked the wife of the noted Arctic explorer to surround them with text that would be informative and accurate. The result is a book that gives an excellent idea of the people, customs, and trading activities of this land of great possibilities.

Here Is Alaska, by Evelyn Stefansson; Charles Scribner's Sons, New York, 1943; 156 pages, $2.50.

Aviation Training Manuals

These encyclopedic instruction books answer the countless questions that any student of flying has to answer. They offer a broad and comprehensive coverage of the program of training approved by the Civil Aeronautics Authority.

Problems that might arise in primary flight training are considered and solved. Equal attention is given to ground courses so that the two volumes give standardized flight and ground instruction adequate to prepare a student for a commercial pilot's certificate. A comprehensive chronology of the history of aeronautics is included and the illustrations are carefully chosen for instruction purposes.

Book I is a primary training manual which follows C.A.A. requirements. It covers fundamental principles of flight, elementary flight instruction, aerology and meteorology, practical avigation, and a digest of the civil air regulations. Book II is intended for those who have had preliminary training and are working for the pilot's certificate or instructor's rating. It includes advanced and aerobatic flight maneuvers, modern aircraft instruments, principles of aircraft engines, airplane structure, radio and instrument avigation.

Win Your Wings, by Col. Roscoe Turner and Major Jean H. Dubuque; Frederick J. Drake & Company, Chicago, 1942; Book I, 691 pages, $3.00; Book II, 460 pages, $3.00.

Aircraft Pictures and Data

A pictorial presentation of the leading contemporary airplanes of the air forces of the combat nations. The gravure reproductions are made from excellent photographs taken, in almost all cases, in flight. A short review giving a sketch of the military and naval aviation development of each country precedes the pictures. Each photograph is documented with a short history of the airplane and its engine and air-frame data. The book is of such great value for reference that it is hoped that it will be followed annually by a similar pictorial review of the airplanes of each year.

Air News Yearbook, edited by Phillip Andrews; Duell, Sloan & Pearce, New York, 1942; 264 pages, $3.75.

Meteorologic Primer

A survey of meteorology essentials. This book offers a study of the science of weather based upon a proved approach developed at the Naval Air Base, Lakehurst, N.J. Comprehension of its subject matter is assisted by il-

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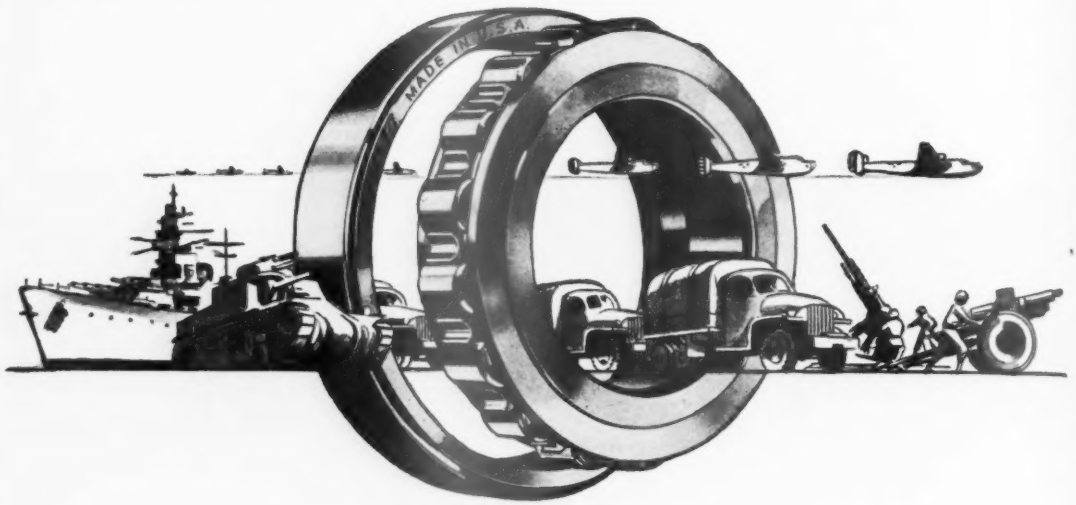

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Prolonging machine life . . . keeping equipment going . . . has been a job done well by Hyatts for the past fifty years. And after this war's won, there will be many more industrial, agricultural and transportation bearing applications in which Hyatts will continue to serve and save for another half century.

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HYATT ROLLER BEARINGS

lustrations, supplementary tables, map problems, and questions for examination and study.

After outlining meteorologic history, the basic concepts of weather science are examined and atmospheric thermal relationships discussed. The text then takes up humidity, temperature, and pressure relationships; pressure phenomena and winds; air masses; traveling disturbances and fronts. It also deals with special storms, fogs and icing conditions, and weather-map analysis and forecasting.

Weather Science, by Lt. Charles William Barber; Pitman Publishing Corporation, New York, 1943; 248 pages, $2.50.

Inverse Tangent Functions

The first contribution to a projected complete set of tables of the inverse trigonometric and hyperbolic functions, this table of arc tan x is offered as probably the most comprehensive so far published with regard to both the number of decimal places given and the smallness of the tabular interval. The tables were prepared by the Mathematical Tables Project conducted by the Work Projects Administration of the City of New York, which has been selecting for tabulation mathematical functions of fundamental importance in pure and applied mathematics. With tables of direct functions available, the value of tables on the inverse functions might be questioned, but the new tables should contribute to a saving of labor, as does every additional table made available to computers, scientists, and technicians.

Table of Arc Tan X, prepared by the Federal Works Agency, Work Projects Administration; conducted under the sponsorship of the National Bureau of Standards, Washington, D.C., 1942; 169 pages, $2.00.

Mathematical Essentials for Aircraftsmen

In writing this book the author's object was to provide aircraft pilots, observers, and ground staffs with a knowledge of the essentials of the various mathematical subjects required in their work. The book is intended for a home-study course and each step is carefully explained with exercises of a practical nature. The reader is not expected to have any previous knowledge of mathematics. This is one of a series of observer's books for aircrews.

The Aircrew's Book of Practical Mathematics, by P. H. Robinson; Chemical Publishing Company, New York, 1942; 149 pages, $1.50.

Handbook for Aircraft Mechanics

The purpose of this handbook is to prepare applicants for ratings as airplane and engine mechanics. It is divided into the three sections on which applicants are examined: civil air regulations, aircraft, and engines. In addition to instruction intended to meet the particular requirements of these three ratings, information is given for meeting the new style of multiple-choice questions. The question-and-answer method is followed for the text matter. There are also pages of diagrams, sectional and construction drawings, and tables covering the components of airplanes, engines, and accessories, as well as methods of effecting repairs. These appendices give instruction on special repairs involving aluminum-alloy structures, weighing procedure and check of balance for alterations, and splicing aircraft cable.

Aircraft and Engine Mechanic's Manual, by Charles Zweng; Pan American Navigation Service, North Hollywood, Calif., 1942; 192 pages, $3.00.

Fundamentals of Flying

This book has a much broader base than an explanation of the operation of aircraft. The author gives, in simple and clear nontechnical language, the fundamentals of the sciences from which flying derived its power. This is an excellent way to get a broader conception of the principles of flying.

The historical section of the book prepares the reader for explanations and descriptions of both heavier and lighter-than-air machines. The aerodynamics of flight and the mechanics of the aircraft engine are treated in the same understandable manner.

After a popular study of weather and its relation to aeronautics, the author concludes with a short sketch of the age-long dream of man from the earliest flying aviators to the possibilities of the future. It is one of the most interesting and informative aeronautical books of the year.

Why Men Can Fly, by M. K. Chapin; Reynal & Hitchcock, New York, 1943; 338 pages, $2.50.

Electrical Shop Course

This electrical shop course has been especially prepared for air-line flight and ground crews. The writer presents a list of the equipment for the use of each group of ten students and also a list of equipment required for examination by the whole class. The book covers 17 periods of shop work. Subjects dealt with include storage batteries, test instruments, a.c. generators, transformers, dynamometers, vacuum-tube rectifiers, condensers, inductors, relays, and magnetos. The shop-work periods are arranged to follow corresponding lecture periods on electrical principles. Sketches and circuit diagrams are provided to aid the student in understanding the work.

Electrical Shop, by John W. Stone; Airlines War Training Institute, Washington, D.C., 1942; 21 pages.

Radio for Flight and Ground Crews

Intended for the use of the instructor and student in the classroom, this book presents information on radio operating for aircraft flight and ground crews. It is arranged in the form of lectures covering the radio operator's duties, the Civil Aeronautics Authority and traffic control, Federal Communications Commission and licenses, calling and answering, procedure signs and signals, instrument approaches, the radio check sheet, and tabulated information, maps and charts. Classroom problems and homework are given at the end of each chapter.

Radio Operating, by John W. Stone; Airlines War Training Institute, Washington, D.C., 1942; 65 pages.

Aerial-Navigation Books

Two additions to the series of Observer's Books on astronavigation have been issued. Part III of this sequence of pocket-size books covers air-navigation stars, the Flower planisphere, methods of solving the position triangle, examples illustrating the use of Weems' star curves, errors in ground observations, and fix errors caused by inaccurate position lines. The fourth volume includes sections dealing with the use of the natural horizon, the flying-boat sextant, running down a position line, errors due to flight accelerations, and ways of obtaining greater accuracy. Other subjects treated are errors which occur in bubble-sextant altitudes due to an aircraft's path curving, the median-marking method, and methods of solving the position triangle. Included in remaining chapters are examples using instruments, table, and maps.

Observer's Book on Astro-Navigation, Parts III and IV, by Francis Chichester; Chemical Publishing Company, New York, 1941–1942; Part III, 84 pages, $1.50; Part IV, 151 pages, $1.50.

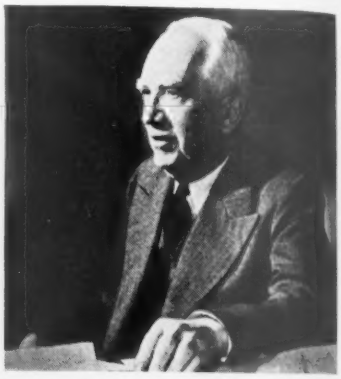
The Chairman Comments on Some Candid Questions About Your Red Cross . . .

At the head of the greatest humanitarian organization that the world has ever seen is Norman Davis, lawyer, industrialist and statesman. Appointed by the President of the United States to meet the tremendous problems of world-wide war relief, he works with quiet energy to raise and spend the millions that the public gives each year.

1. Yes, the sums that we ask of the public *are* large in spite of the fact that 95% of the labor involved is volunteered. But the necessities of world relief and our Congressionally authorized obligations to the Armed Services justify every dollar of expense.

Over forty million dollars spent since last January for services to the Army and Navy, increasing as the armed forces increase, and the war fronts multiply. And the increase is just as rapid in the requirements of Foreign Relief and Home Service.

2. Perhaps it's your fault if you haven't "seen the figures." We publish them as fast as the War Department auditors can give them to us, and if you haven't happened to see them as published, your local Chapter has them for your inspection.



3. No, it's not a complex or top-heavy organization. In Washington, eighteen of us through the Central Committee are the plan board. The Chairman, and five representatives of Government Departments are appointed by The President. The others are elected and Chapters have full representation. The Central Committee creates policies and plans the adoption and operation of which is entirely in the hands of the Chapters. There is every safeguard to keep the Red Cross democratic.

4. All the questions that you can think of about Red Cross get answered very quickly when you're in the work itself. You commence to realize what a tremendous army of good will the Red Cross is and what a big part it is playing in making this poor old world a little better place to live in.

There are many ways for you to help. Your chapter welcomes volunteers.

A Peoples' Partnership

So many of us are in it, all over the country in little towns and big cities.

Business men working shoulder-to-shoulder on Chapter operations.

Housewives taking hours from home in the production rooms. Women who volunteer for Nurse's Aide or Motor Corps or Canteen Work.

And a reserve coming up of millions of school children in the Junior Red Cross.

And that is just the home front. Out over the world stretches the "big business" of administering Red Cross relief. It is still the people's business, made possible with their money, and their good will. A business of warehousing, trucking, car-loading and shipping. Of tons and tons of food and clothing and medical supplies, and of personnel and organization to get it all to where it is needed in time to be of the greatest good.

"Big business" in the best meaning of the term and it is such business and the man power that goes with it that has nearly absorbed the millions that you gave to the Red Cross War Fund a year ago—every penny of it went to the needs of war.

And now another War Fund must be collected. The President of the United States has designated March as the Red Cross month. Your Chapter needs your help.

Your Dollars help make possible the

AMERICAN RED CROSS

This space contributed by the Publisher

Marvels of Research

In presenting a book telling of what science is creating in the industrial laboratories of the nation, the author has drawn on information from many sources. Discoveries that are influencing the daily life of the individual are described in nontechnical language. Discussing new frontiers of science, the author notes that until about the beginning of the Twentieth Century there was little effort to coordinate industry with research. How the situation has changed since that time is explained. Reference is made to the great amount of research which is being carried out in the laboratories of corporations and the Federal Government. The results of modern research are revealed in chapters describing new industrial products and other discoveries in the fields of chemistry and physics. Of particular interest are chapters dealing with explosives in peace and war, the fuel for tomorrow, rubber from the tree and test tube, new metals, electronics, radio, and new sources of power. A chapter is devoted to aeronautical developments. Some other subjects covered include chemicals for cures, light and light sources, vitamins, etc.

Science Remakes Our World, by James Stokley; Ives Washburn, Inc., New York, 1942; 298 pages, $3.50.

Hydraulics for Flight and Ground Crews

Principles of hydraulics are set forth in this series of lectures prepared for flight and ground crews. These lectures are intended to be used in conjunction with a shop course in hydraulics. The book is divided into sections each of which represents approximately one hour of lecture work. Example problems and classroom problems are presented at the end of each lecture. The material was not prepared for home study, but for the use of students and instructors in the classroom. Diagrams aid in clarifying the principles presented.

Hydraulic Principles, by James W. Etchison; Airlines War Training Institute, Washington, D.C., 1942; 115 pages.

Explanations for Novices

This book for boys states that Orville Wright, in the first flight at Kitty Hawk, "shot from a catapult like a rock from a slingshot" and sat upright. An illustration also shows a wheel control and a vertical engine, all of which indicates the carelessness with which some of the facts of the book are presented. Evidently the author accepted these and other statements made in books and newspapers and did not check them.

Books that stimulate an interest in flying by young men and young women are in great demand, but it is important that the facts be presented in such a way that they do not give incorrect impressions.

How a Plane Flies, by Charles Gilbert Hall; Funk & Wagnalls Company, New York, 1942; 235 pages, $2.00.

Commemorating a Historic Event

This year marks the 150th anniversary of the first air voyage in the United States. It should not be confused with the first balloon ascension, which occurred in Baltimore in 1784 when Peter Carnes exhibited his balloon and Edward Warren, a boy of thirteen, made the first ascent in this country. As Carnes' balloon was undoubtedly of the captive type the credit for the first balloon voyage rightfully belongs to Blanchard.

This book is a commemorative volume containing a reprint of Blanchard's pamphlet describing the flight, which was issued in 1793. As the pamphlet is rare and in few libraries, this book will make it available to many other collectors. Carroll Frey has written a scholarly background sketch of the voyage which adds greatly to Blanchard's own account.

The life and citizens of Philadelphia in 1793 are portrayed with great skill so that the reader has a vivid picture of the conditions under which this daring flight was made. The book is not for sale and may be secured only by gift from the insurance company.

The First Air Voyage in America; The Penn Mutual Life Insurance Company, Philadelphia, Pa., 1943; 27 pages.

Imaginative Adventures in Science

Probably no other writer has had such an influence on the public in creating an interest in aeronautics as the French imaginative writer, Jules Verne. This biography relates how he became interested in air voyages from his contact with Nadar, the balloonist. He wrote a history of ballooning, but his publisher suggested that he novelize it and *Five Weeks in a Balloon* was the result. Its success induced Verne to write of other pseudoscientific adventures. His *From the Earth to the Moon* was an early conception of rocket flight. In *The Mysterious Island*, the balloon, a desert island, and the adventurous Captain Nemo were combined. *Clipper of the Clouds* appeared at a time when the dime novel was popular and without doubt stimulated the writing of many of these imaginative and lurid adventure stories. Jules Verne has a place in any history of aeronautics even though his work was imaginative.

Jules Verne—The Bibliography of an Imagination, by George H. Waltz, Jr.; Henry Holt and Company, New York, 1943; 223 pages, $2.50.

France's Military Catastrophe

Although the author does not believe that "aviation will revolutionize the art of war," he gives some interesting figures about the relative strength of the German and French air forces in the conquest of France. In his opinion the Germans employed 6,000 of their total of 8,000 first-line planes, but the French had only 1,100 planes of first-line types on the northeastern frontier. The French lost 1,000 airplanes in the fighting, some in the air and many on the ground.

The study of strategy of the French and German armies is described from the point of view of a French staff officer. He admits frankly the backwardness of the defense, its obsolete equipment, political handicaps, and industrial lethargy. He traces their deficiencies to earlier military history and attributes the debacle to the resistance of the French to new ideas or forward-looking leadership. The book only refers to the part aviation plays as an adjunct to ground forces.

War in the West, by Daniel Vilfroy; Military Service Publishing Company, Harrisburg, Pa., 1942; 163 pages, $2.50.

Elements of Flying

The elementary principles of flight are set forth in a book written especially for aircraft flight and ground crews. Prepared for the use of the instructor and students in the classroom, this book is divided into sections each of which represents one hour of lecture. The method of presentation is such that students entirely unfamiliar with flight principles should be able to acquire a fundamental knowledge of the subject with a minimum expenditure of time. The material in the book was not prepared for home study. There are many diagrams that help to clarify explanations, and classroom problems are presented at the end of each lecture.

Flight Principles, by Sherman E. Crites; Airlines War Training Institute, Washington, D.C., 1942; 65 pages.

POWER GUN for CHERRY BLIND RIVETS

Positive mechanical action is the most important single attribute to the successful operation of the Cherry Blind Rivet. Head formation and shank expansion are produced by a pulling force exerted on a mandrel passing through the rivet. A continuous pull may be applied by a pneumatic gun as shown above, or in field work, where air power is not available, a hand-operated gun may be used.

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Hazardous Service

The jumpers have caught the fancy of the public since their hazardous work has become better known. Their military use by the Russians and Germans as offensive troops caused a sudden all-out training program by the U.S. Army. Although the development of the military type of parachute may rightly be credited to the Army and more particularly to old McCook Field, its use was almost entirely limited to emergency jumps.

The author takes the reader through the routine life and training of a paratrooper and describes the many weapons that he must be able to use. A brief history of the parachute gives the background of the employment of this military accessory that is used by the "cold jugs." The illustrations are well chosen and show the varied activities of this colorful division of the Army.

He's in the Paratroops Now, by A. D. Rathbone, IV; Robert M. McBride & Company, New York, 1943; 190 pages, $2.50.

Aeronautical Book List

There is such a constant demand for lists of books about aviation that this compilation will render a valuable service. The classified bibliography will give teachers and students lists in various fields that have been carefully selected. The general lists give a short summary of each of the recommended books, enough to let anyone know whether they would be useful for personal use or in libraries.

To the main portion of the book are added descriptive lists of aeronautical magazines, pamphlets, and maps.

The use of motion-picture films in educational work is so important that this essential activity in teaching is included in the bibliography. Under the title "Films and Film Strips" is a list of aeronautical films, their cost, where they may be purchased or borrowed, and a short description of each.

Bibliography of Aviation Education Materials, by Catherine Cartwright, Robert S. Fisk, Carrie Meares, Kenneth Lant, and George F. Stover; The Macmillan Company, New York, 1942; 139 pages, $0.88.

The Dieppe Raid

For those who have questioned the purpose of the daring raid on Dieppe when the Canadian and other English troops landed in the morning and left in the afternoon, this book will be enlightening. The author believes that even though the Canadians lost 3,350 killed, wounded, or missing of the 5,000 who landed, the experience in coordinating the sea, air and land forces was worth the heavy cost.

Emphasis is given to the discovery that the German air forces were caught off guard and that it took several hours for them to assemble enough airplanes to interfere with the landing. Meanwhile, the Royal Air Force had kept an air "umbrella" over the landing. The raid tested the German defenses along the French coast and demonstrated once again that no invasion even on a small scale can hope to succeed without adequate air protection.

We Landed at Dawn, by A. B. Austin; Harcourt, Brace and Company, New York, 1943; 217 pages, $2.00.

Neglected Strategic Frontier

No one can read this book without realizing the tragic neglect of the key to the defense of the United States. But it is encouraging to know that something is now being done to make Alaska a defense outpost instead of a vulnerable place from which an attack on our northern cities could be made. The author tells as much as she can about the great effort to make Alaska a military and naval base for operations eventually against Japan. She gives a first-hand account of her travels by boat and airplane through the territory and her interviews with military and civil authorities, pilots, miners, business men, trappers, and farmers.

The author writes from an impartial point of view and gives the reader a familiarity with our Arctic land and people which should help in creating a greater interest in the country that General Mitchell called "the most important strategic place in the world."

Alaska Under Arms, by Jean Potter; The Macmillan Company, New York, 1942; 200 pages, $2.00.

Book Notes

Forgotten Front, by John Lear; E. P. Dutton & Co., Inc., New York, 1943; 256 pages, $2.50.

An Associated Press correspondent made an airplane trip in Peru to Iquitos, the last link in the chain that the Condor Tampa air line was forging for a possible invasion of South America or attack on the Panama Canal.

The book not only describes the life of the Peruvian natives but gives a harrowing account of the plane carrying the author and the pilot being forced down in the Sechura Desert and their ordeal in reaching the Pacific after many exciting adventures.

Aircraft Identification, by Major Frederick R. Hazard; Garden City Publishing Company, Garden City, N.Y., 1942; 96 pages, $0.25.

This manual is offered as a practical guide for all those engaged in the Aircraft Warning Service. It will also be found useful to anyone interested in familiarizing himself with the types of aircraft being produced today. Both elementary and advanced information on the identification of aircraft is furnished in this series of lessons for aircraft observers.

Mr. England (the Story of Winston Churchill), by Paul Manning and Milton Bronner; The John C. Winston Company, Philadelphia, Pa., 1942; 282 pages, $1.50.

For those who wish to learn more about the background of the great war leader of England, this book will provide the history of his interesting life written in a popular manner.

It gives his family background; his early life and education; and his experiences during the Boer War, the first World War, and in politics, insofar as they have a bearing upon his present actions. While telling frankly of his political mistakes, it details the many times he predicted events with uncanny accuracy. The reasons he holds the confidence and respect of his people are graphically portrayed.

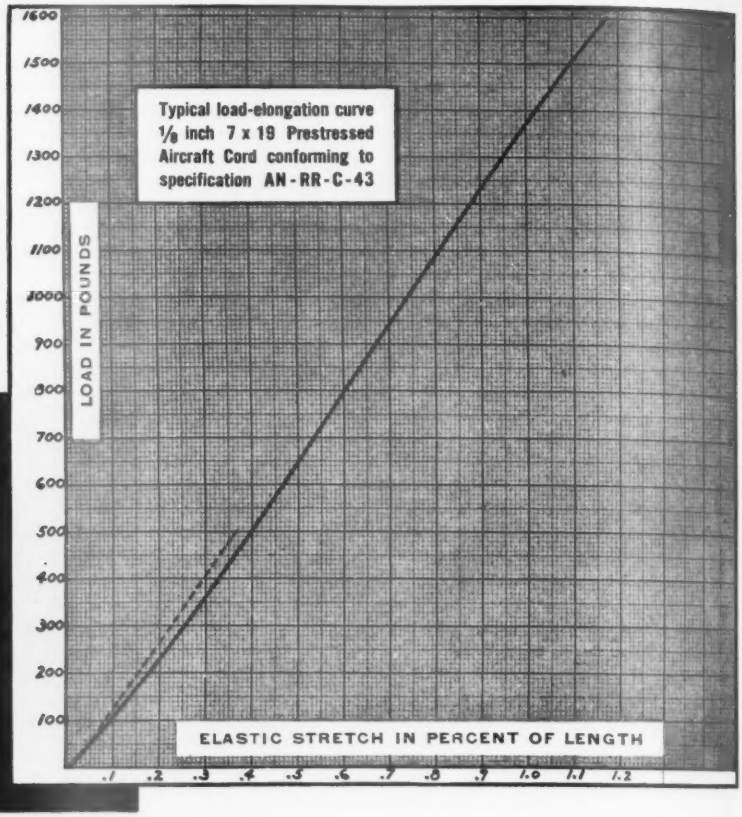
Ground Instructor, by Charles A. Zweng; Pan American Navigation Service, North Hollywood, Calif., 1942; 336 pages, $3.00.

Ground Instructor Rating, by Charles A. Zweng; Pan American Navigation Service, North Hollywood, Calif., 1942; 157 pages, $3.00.

In a new revised edition of *Ground Instructor* an attempt is made to provide material covering the ground instructor basic course. The text covers the history of aviation, aircraft and the theory of flight, aircraft power plants, instruments, aerial navigation, aeronautical meteorology, civil air regulations, and air-traffic rules. The book is intended for the use of rated ground instructors in class work, class examinations, and general instruction, while the material should be equally valuable to commercial or private pilot applicants in preparing for Government examinations.

As a primer for the final examinations, the author recommends that

Elastic Properties of AIRCRAFT CORD



BEFORE considering the effect of elastic properties on cord stretch in aircraft control systems, it is necessary to understand the effects of purely constructional stretch. This is unrecovered stretch which starts as soon as the cord is placed under stress. Its extent depends not only on the load imposed but also the time during which the load acts. For example, the constructional stretch in a 7 x 19 preformed carbon steel aircraft cord stressed at 60% of its listed strength for 50 hours, amounts to approximately 0.20% of the cord's total length. Approximately 75% of this stretch occurs within the first 15 minutes.

It is customary to prestress aircraft cord at 60% of its listed strength for 3 minutes. This procedure removes that part of the constructional stretch which would occur at the loads under which the cord normally operates. This prestressing is best carried out just prior to installation, since handling enables the cord to recover a small part of its constructional stretch. A proof-testing and prestressing rig suitable for this operation has already been described in a previous advertisement. Blue prints of this device are available without charge.

Once the constructional stretch has been removed from aircraft cord, it behaves like any other elastic material. That is to say, it is subject to *temporary* stretches, which, within the cord's elastic limit are directly proportional to the applied load, regardless of the time during which the load acts. The accompanying load-elongation curve illustrates this purely *elastic* stretch. It will be noted that the curve is a straight line only after the load reaches a magnitude of some 15 to 20% of the cord's listed strength. This is a factor which is often neglected when analyzing the stretch characteristics of aircraft control systems. Sometimes, for example, the stretch between two load values is computed from the modulus of elasticity of the straight line portion only of the stress-strain curve. The dotted line on the graph illustrates that when computed in this manner the stretch corresponding to a load increase from 50 to 500 lb. is seen to be about 10% less than the actual stretch.

Proper use of the above suggestions will enable designers to overcome objectionable characteristics. The entire problem of cord stretch, of course, requires further details and study by aircraft engineers concerned with specific problems. Engineering data or technical help will be supplied by the Roebling Engineering Department upon request.

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students use *Ground Instructor Rating* as an auxiliary text. The revised edition was prepared to meet the conditions imposed by new methods of examination that have come into use. Questions concerning methods of teaching are now asked of instructor applicants, and, to meet this need, the chapter on methods of instruction and classroom work has been enlarged in such a way that careful reading and study should provide the answers to most of the questions asked by the inspector. Another point covered is the new method of multiple-choice questions created by the Civil Aeronautics Authority. It is said that applicants must be well grounded in the subjects on which they seek ratings before they can expect to pass this examination.

The text covers the five principal subjects now taught in ground schools: the airplane and aerodynamics, aircraft power plants, air navigation, aeronautical meteorology, civil air regulations. It is intended to prepare applicants with regard to the type and scope of the written examinations and should be used in conjunction with *Ground Instructor* or other good texts covering this rating. It is also recommended for preparation to undergo an oral examination that may be required, as well as the multiple-choice type of question. A glossary includes aeronautical, technical, and navigational terms; meteorology; abbreviations and symbols; and civil air regulations.

Plastics for Industrial Use, by John Sasso; McGraw-Hill Book Company, Inc., New York, 1942; 229 pages, $2.50.

This is an engineering handbook on important plastic materials and methods that are particularly suited to industrial applications. Information is furnished on the comparative properties of plastics, the methods of selecting plastics for specific uses, and proper design. Basic data required before any plastic can be adapted to engineering use are presented in early chapters of the book. Practical information on the properties of specific plastics is given in later chapters, one chapter being devoted to each specific type. The chemistry of plastics, except as it affects strength or performance, is not included because the handbook is intended for mechanical engineers.

Bombs, Buildings and Shelters, by William H. Hayes; Columbia University Press, New York, 1942; 83 pages, $0.60.

Based on a series of lectures given at Columbia University, this booklet deals with the subject of domestic air-raid shelters. It is intended to provide the layman with a basic understanding of the fundamentals of the subject, rather than to treat exhaustively all of its aspects. A brief analysis of residential construction in terms of air-raid protection is given; materials and construction of shelters are examined.

Flying by Instruments, by Frederick H. Smith; National Aeronautics Council, Inc., New York, 1942; 153 pages, $1.50.

Probably no advance made in the technique of flying has been so important as that caused by the numerous instrument aids now available to the pilot. The gyropilot, new compasses, loop direction finders, and refinements of other instruments are described and their uses are explained. The student is acquainted with blind landing systems and the relative merits of ground and aircraft directional radio systems. The book was written by a pilot with long practical experience and gives to the student pilot the essential information he requires for his training.

Chapters cover instrument flying and practice, course keeping by radio and gyro, flying by gyro and compass, and use of the radio compass and the turn indicator. The concluding chapters are devoted to radio airport approach and to a discussion of the relative merits of ground and aircraft directional radio systems.

Four Miles South of Kitty Hawk; Warren McArthur Corporation, New York, 1942; 75 pages, free.

Presented in brief paragraph form, this is a "scot" history of aviation. Its contents include an "Almanac of the Air"; sections on the Wrights, Glenn Curtiss, and Glenn L. Martin; and chapters on the development of aviation in the two great wars and the period between them.

Drawing the R.A.F., by Eric Kennington; Oxford University Press, New York, 1942; 143 pages, $3.00.

A collection of portraits of Royal Air Force men. Each drawing is accompanied by a brief biography of its subject, but the vividness of the portraits themselves depict the spirit of the Force.

Airplane Andy, by Sanford Tousey; Doubleday, Doran & Company, Inc., Garden City, N.Y., 1942; 44 pages, $1.00.

This book for juniors relates the story of a boy on an airplane trip who helps to bring the plane safely through a storm. From it the reader learns something about the operation and construction of an airplane, particularly with regard to the instrument panel.

Wings for Juliet, by Marie Blizard; Arcadia House, Inc., New York, 1942; 272 pages, $2.00.

This novel is based upon the activities of an attractive young woman who uses flying as one of the means employed in furthering her social ambitions. It tells how the daughter of a small-town college professor seeks to avoid the usual routine of life in a small community by taking flying lessons. The book refers to aeronautical matters principally as an incidental part of the main action of the story.

Plant Protection, by E. A. Schurman; Cornell Maritime Press, New York, 1942; 148 pages, $2.00.

The organization and administration of an efficient plant protection department are outlined. An operating plan and procedures are suggested, with the duties of the department well defined. Problems of reorganizing an existing setup, as well as those connected with installing a new department, are discussed.

Plastics, by V. E. Yarsley and E. G. Couzens; Penguin Books, New York, 1942; 159 pages, $0.25.

This is a reprint of a booklet first published in 1941. It explains the physical properties and characteristics of plastics, their manufacture, applications, and significance. The new edition introduces material additional to the old.

Air Raid Protection and First Aid, by Addison Webb; Book-of-the-Hour Company, New York, 1942; 32 pages, $0.25.

This is the revised edition of a pamphlet containing information on the fundamentals of first aid. Compiled from official sources, these instructions tell what to do in meeting the dangers encountered during air raids. Data are given on bombs, poison gas, and fire, how to prepare a refuge room, necessary supplies, and on-the-spot treatments for various types of accidents.

Flight Handbook; Flight Publishing Co. Ltd., London, England, 1942; 203 pages, 6s.

The scope of this revised edition has been extended by the addition of a section devoted to typical aircraft power plants with some accompanying notes on supercharging. Included is information on aircraft structures, instruments, and airscrews, also a chapter on superchargers, including those operating on the exhaust-turbo principle. Mathematics have been avoided in explaining important structural and aerodynamic principles. In the new chapters on aircraft engines, descriptions are given of the Rolls-Royce Merlin XX, Bristol Hercules, Allison, Napier Dagger and Mercedes-Benz units. Many of the drawings in the handbook were taken from the pages of *Flight*.

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Loading and Cruising, by John J. Ford; Airlines War Training Institute, Washington, D.C., 1943; 134 pages.

Intended for instructors and students in the classroom, this book for aircraft flight crews is divided into two parts, one dealing with the loading of airplanes and the other containing information on cruising. Example problems are furnished at the end of each lesson. Charts and drawings are furnished to clarify the principles set forth.

A. R. P. For Canada, by Vera Knight; The Macmillan Company of Canada Limited, Toronto, Canada, 1942; 76 pages, $0.25.

This booklet provides an outline of what to do in case of air raids and is specifically concerned with the problem as affecting Canada. It explains different types of bombs and methods of dealing with them, types of gas warfare, and the civilian defense services. It gives useful hints on air-raid precautions in the home, black-out preparations, types of shelters, and ways of aiding civilian defense. First aid for war casualties is also covered.

Dictionary of Technical Terms, by F. S. Crispin; The Bruce Publishing Company, Milwaukee, Wis., 1942; 373 pages, $2.50.

Prepared for the use of draftsmen, mechanics, builders, electricians, and workmen generally, this revised dictionary is intended to assist such workers in understanding technical terms with which they are in daily contact. While not containing all the technical terms in any field of endeavor, the scope of the book is broad enough to provide the workman with a knowledge of trade nomenclature which will be useful in the pursuit of his vocation.

Know Your Navy Now! by Lt. Francis A. Ford; Cornell Maritime Press, New York, 1943; 84 pages, $1.00.

Highlights and sidelights on the U.S. Navy are presented in concise quiz style by a retired naval officer. Many things that the average American should know about the Navy are set forth in easily understood language. The book includes sections covering Navy enlisted men, ships, general information about the Navy, Navy expressions, the U.S. Marine Corps, the U.S. Naval Academy, and Navy officers.

Fire Protection in the Airplane Industry, by Winthrop M. Jones; Factory Insurance Association, Hartford, Conn., 1942; 70 pages.

A pamphlet written to aid industrial engineers in designing and equipping plants for the manufacture of all-metal airplanes in such a way that serious property damage from fire, explosion, and windstorm may be averted. The information is based on present-day practices in the industry in which heavy noncombustible and fire-resistive types of building construction have predominated.

The subject is presented under sections dealing with building areas and heights, construction and arrangement, occupancy and hazards, testing, and special hazard protection. Other sections cover automatic sprinkler protection in general, water supply, underground fire-protection system layout, and first-aid protection. A table is included covering the fire-retardant ratings of walls and partitions.

A Yankee Flier in the South Pacific, by Al Avery; Grosset & Dunlap, New York, 1943; 208 pages, $0.50.

This adventure story for youngsters relates the exploits of an American flier fighting in the Coral Sea. The fliers and his friends are faced with incredible odds but, as is to be expected, emerge victoriously.

The Pursuit Patrol, by Franklin W. Dixon; Grosset & Dunlap, New York, 1943; 214 pages, $0.50.

One of the Ted Scott Flying stories for boys. The hero's ability as a pilot forms the core of this story.

Photogrammetry, by H. O. Sharp; John Wiley & Sons, Inc., New York, 1943; 129 pages, $3.50.

Designed for both classroom instruction and office reference, this is the third edition of a book on photographic surveys. It presents the fundamental principles involved in both terrestrial and aerial photographic surveying and a discussion of their application to mapmaking. Instruction in the use of popular photogrammetric instruments is also given.

Plastics Problems and Processes, by Dale E. Mansperger and Carson W. Pepper; International Textbook Company, Scranton, Pa., 1942; 352 pages, $3.00.

While this is a revised edition of a book published in 1938, so many changes have been made and new material added that it may practically be regarded as a new book. The new edition is designed to meet the needs of students and professional men as well as the average layman. There is an enlarged section on the history of plastics, and a section on commercial applications of plastics has been added. The future of plastics is also discussed.

Celestial Navigation, by Elbert F. Blackburn; Airlines War Training Institute, Washington, D.C., 1942; 122 pages.

This course in celestial navigation is prepared especially for aircraft flight crews and their instructors. It is divided into sections, each of which represents one hour of lecture. Fundamental information on aerial navigation is presented with the aid of drawings and charts. Problems for the student to solve are furnished at the end of each section and homework is also provided.

Problems in Aviation, Globe Book Company, New York, 1942; 15 pages, $0.24.

This is a supplement to two mathematics textbooks: one is *Adventures in Algebra, Second Course,* by Leventhal, Salkind and Seymour; the other, *Plane Trigonometry* by Hayes and Leventhal. Based on the studies in these two books, it presents 55 problems with specific aeronautical application.

Battle for the Solomons, by Ira Wolfert; Houghton Mifflin Company, Boston, 1943; 200 pages, $2.00.

An experienced newspaperman gives his impressions of the air, sea, and ground phases of the first part of the attack on the Solomons. His description of the use of aircraft is vivid and personal, since he flew down the skyway from Honolulu and went on one of the missions with the air squadron. He saw one of the most exciting air duels of the war.

Renfrew Flies Again, by Laurie York Erskine; Grosset & Dunlap, New York, 1942; 288 pages, $0.50.

One of a series of boys' books on the Royal Canadian Mounted Police. The utilization of airplanes by mining syndicates in the northwest forms a background for the tale.

Military and Naval Recognition Book, by J. W. Bunkley; D. Van Nostrand Company, Inc., New York, 1942; 347 pages, $2.50.

This is the third edition of a handbook on the insignia of the world's armed forces, the organization of the American services, and the latter's etiquette and customs. Insignia of rank, decorations, distinguishing features of each service, and uniforms are described and illustrated. Revisions include subject matter referring to the reorganization of the U.S. War Department, changes in the organization of the U.S. Navy ashore and afloat, reorganization of the U.S. air force, various changes and additions in Army and Navy insignia, and the addition of new ribbons of medals recently authorized.

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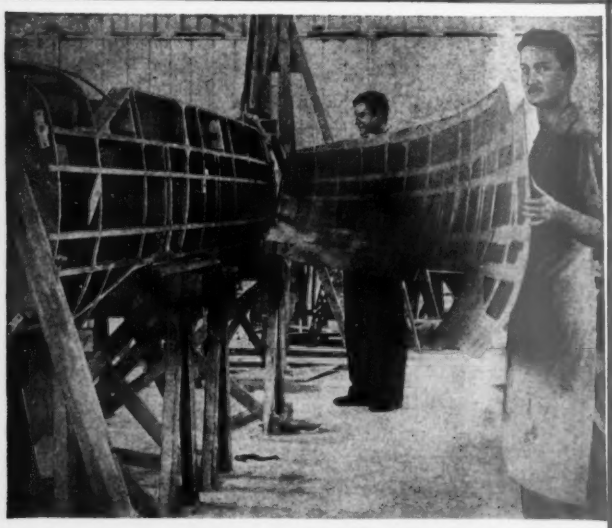

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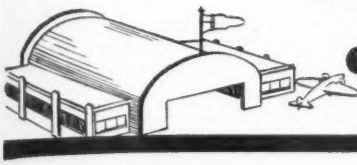

Aircraft Hardware

Catalogue No. 101 describes Aeroscrew hexagon and drilled-head bolts, clevis bolts and pins, fillister and washer head screws, threaded taper pins and other Army-Navy aircraft hardware. It includes tables of engineering data and sketches giving dimensions and tolerances. Prices are also quoted. *Aeroscrew Company*, Rockford, Ill.

How Airplanes Are Built

A Bomber Is Born. This is the introduction to a series of articles describing the creation of a Martin bomber from idea to take-off. It gives a brief outline of the entire procedure, which will be followed by detailed breakdowns in subsequent articles. *The Martin Star*, February.

Magnet Wire

A catalogue is offered on Formex magnet wire, describing its properties, methods of manufacture and applications. The development of the product is traced and the processes of manufacture are described. Detailed information is given on the properties of the wire, its advantages in use, the types available, and the uses for which it is suitable. Tables give data on sizes, weights, and resistance in which this wire is available. *General Electric Company.*

Small Lot Stampings

Metal Stamping in Small Lots is the title of a new booklet giving information on facilities that are available for the production of metal stampings in small lots where the cost of conventional dies would be so large as to be almost prohibitive. This service is intended to meet the widespread need for small-lot production facilities in the stamped metal products industry based on the creation of dies of original design on a production basis.

The history of the company is traced, including its growth from 1921 to its present status. The equipment and layout by which large numbers of individual orders are handled expeditiously, are described and illustrated in considerable detail. Comparisons are made between sand castings and die castings which help to determine the relative suitability of the two processes. Examples of the cost savings that have been effected in representative jobs are demonstrated by drawings and descriptions. *Dayton Rogers Manufacturing Co.*, Minneapolis, Minn.

Training Airacobra Service Specialists

Bell-Made Mechanics. Details are given on Bell Aircraft's "Service School at the Assembly Plant." Of twelve weeks' duration, the course given at this school is divided into eight phases: shop practice landing gear, electrical, propellers, power-plant structures and control, familiarization, and armament. It is designed to make Airacobra service specialists of men who are already skilled airplane mechanics. The student's schedule is divided into one week of shop practice, six of book theory, four weeks of flight line experience, and one week as an assistant instructor. In addition to its regular students, the school is also attended by new test pilots (who go through a special course of only two weeks), returned representatives, company and Army inspectors, supervisors, shop foremen, and enlisted personnel of the Allied nations.

This article includes a description of the latest adjunct to Bell's Service School . . . . a mobile instruction unit that travels from one Army base to another. Three such units are now in operation, one in the southern part of the United States, the other two on the west coast. *The Bellringer*, February.

Stainless Steel Aircraft Parts

Stainless for the Ford Bombers. The story of how the Murray Corporation of America, producers of assemblies for motor cars, has changed to the volume production of stainless-steel parts for Ford bombers is told in this article. The writer explains that the company is successfully using draw dies to form stainless-steel cowlings, ammunition boxes, exhaust collectors, and other parts instead of the drop-hammer method. *Steel Horizons*, Vol. 4, No. 5.

Metal-Duplicating Catalogue

Catalogue No. 43-4 is the fourth issue of a booklet on the *Di-Acro System of Metal Duplicating Without Dies.* In addition to an outline of the process and the work it is intended to accomplish, the new edition contains information on an improved Di-Acro shear, an improved Di-Acro brake, and an entirely new Di-Acro Shear No. 3. Other models of shears, brakes, and benders are included, together with parts made with these devices, applications of Di-Acro machines in war production, and other matters. The construction and operation of these machines are described in considerable detail in this 32-page booklet, which contains many illustrations and a page of questions and answers about the system. *O'Neil-Irwin Manufacturing Company*, Minneapolis, Minn.

Spare Parts Methods

Spare Parts Are Life Insurance for the Men and the Machines on the Battlefronts. Tye M. Lett, Jr. Based on his experiences as an overseas representative of the Allison Division of General Motors with the American Volunteer Group in Burma and China, the writer tells of methods for spare-parts control that have helped to maintain American combat airplanes in foreign war sectors. The opinion is expressed that more study should be given to the elimination of waste in ordering parts, to review and analysis of the unit ordering system, and to standardization. His recommendations are summarized under seven headings covering centralized handling of supplies, multiple communications, mobility of ground crews, adequate earth-moving equipment, well-camouflaged tributary fields, improved ordering systems, and standardization of aircraft. Illustrations show the methods of handling spare parts and materials at the factory. *GM Folks*, January.

Growth of a War Plant

This is Our Story. By numerous illustrations and brief paragraphs, the history of Douglas Aircraft Company is traced from its pioneer days to its present place in the nation's war program. The story is related of the development of the predecessors of the Douglas Devastator torpedo bombers, the DC-type air-line transports, the Skymaster Army cargo carriers, and the B-19. Other pages tell how scientists, teachers, and other leaders have joined with the plant workers and those

More Durable, More Foolproof Wood Aircraft Assembly

NOW POSSIBLE WITH NEW NON-ACID "WARM-SETTING" PHENOL RESIN GLUE!

WE invite your inquiries about a newly developed phenol-formaldehyde resin glue which sets new standards for wood aircraft assembly—with these outstanding qualities:

DURABLE—Produces typical boilproof, fungus-proof phenol-resin bond.

NON-ACID—The set film is *slightly alkaline*, far exceeds AN-G-8 requirements. Eliminates known weakening of wood that occurs with use of highly acid catalysts.

FOOLPROOF—Set resin is non-crazing, has good gap-filling qualities. Makes strong bond on joints where perfect fit may be difficult or impossible to attain.

LONG ASSEMBLY—Permits immediate pressing—or up to 1½ hrs. may elapse between application and pressure.

WARM-SETTING—Sets in warm storage room (140° F.).

Since this announcement was made last November, several of America's most important wood aircraft manufacturers have begun experimental use of CASCOPHEN LT-67. Successful production use on special constructions is established.

● We are glad to supply latest information on this new glue to assembly plants, on request. Address: Casein Co. of America (Dept. AR3), 350 Madison Ave., New York, N.Y.

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Aircraft Glues

Phenol-resin, Urea-resin and Casein glues to meet all aircraft requirements

of other companies in the creation of a great industry contributing its full efforts to the winning of the war. *Douglas Aircraft Company, Inc.*

School for Soldiers

Camp Bell. An account of Bell Aircraft's technical school for enlisted men. This school was established in cooperation with the Army Air Forces Technical Training Command for the purpose of teaching soldiers, already trained in airplane mechanics, to become Airacobra specialists. Fifteen days of schooling are spent on lectures and practical demonstrations; two days are spent in a practice hangar, and ten days at a Modification Center working with civilian plane crews. Note is taken of the barracks where these student-soldiers live and the classrooms. *The Bellringer*, February.

Atmosphere

Health Topics. Col. A. D. Tuttle. Second in a series of articles dealing with the atmosphere. This one is concerned with the altitudes reached by man and how they affect him as he goes aloft. Altitude records obtained by balloon and airplane are reported. With methods of combating the physical effects of higher altitudes briefly indicated, these effects are designated as reduced atmospheric pressure and extremely cold temperatures.

The article also notes that United Air Lines has participated in studies of cosmic rays and the concentration of pollen in the air during hay-fever seasons. *United Air Lines News*, January.

Air Transport in War

Magic Carpet to Buna. Bill Henry. An article describing the important part air transport is playing in war activities of the South Pacific. The writer tells how transport planes are taking an army across the Owen Stanley range of New Guinea, a few men at a time. He explains that the transport planes make the trip from Port Moresby to Buna in 20 min., while experienced jungle pack men take two weeks to cover the same route on foot. *Douglas Airview*, November-December.

Aluminum Cleaning

Cleaning Aluminum Alloy Parts Prior to . . . Spot Welding. R. E. Anthony. It is stated that leading welding engineers attribute at least 75 per cent of the difficulties encountered in spot welding of aluminum-alloy parts on a production basis either directly or indirectly to improper cleaning. Methods are suggested for securing better results in the matter of cleaning, the writer first showing the ways in

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Millions of Littelfuses are in all branches of the Services—meeting *to-day's* unprecedented demands with NEW design and construction.

Terrific vibration and shock, sudden temperature changes from 60° below zero to 120 above, are withstood by exclusive Littelfuse factors.

Littelfuse Depolarization (illustrated below),

Littelfuse "Gooseneck," spring-forming at end of element, taking up contraction and expansion,

Littelfuse Locked Cap Assembly, sealing element against "perspiration," and preventing caps from ever loosening.

Mechanically Depolarized
FUSE ELEMENT

Twisted at 90°, Littelfuse elements are mechanically depolarized—protected against vibration from any direction. Hold against tests 10 times worst field conditions. Littelfuse of 5 amps., or less have spring-and-link element.

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which defective welding is caused by improper cleaning. Each of these cleaning methods is detailed and particular attention is given to cleaning by the submergence of aluminum parts in an acidic solution. Advantages of the chemical method are emphasized. *The Houghton Line*, December.

Plastic and Plywood Construction

Regarding "Plastic" Planes. To correct misinformation and misunderstanding about the construction of aircraft and airplane elements by modern wood processes the first of a series of discussions by members of the Duramold Division of Fairchild Engine & Airplane Corporation is presented. Maintenance of contour and smoothness of surface are held to be among the most important advantages, as well as the saving of strategic metals. Structural and aerodynamic advantages are stressed. The Duramold processes are explained and compared with earlier processes. Descriptions of the two methods, called thermosetting and thermoplastic, give details of their application and characteristics. This article is devoted to the reasoning back of the Duramold development and shows how, in general, it differs from other broadly described bag-molding processes. In a forthcoming article the raw materials, adhesives, and finishes will be discussed, covering the application of the process to the manufacture of shells and structural frameworks and to the assembly of the shells on the framework. *The Pegasus*, February.

What the Airacobra Costs

Plane Figures. The work of the Cost Estimating Department of Bell Aircraft is outlined. This unit keeps account of the dollar value of every item in the Airacobra, the number of operations, and the time involved to fabricate them. They are also responsible for the establishment of a cost value on all tools and fixtures either made in Bell's machine shop or purchased outside. Cost estimating of spare parts is also an integral part of the department's function. *The Bell-ringer*, February.

Catalogue Service for Aircraft Design Engineers

United States Rubber Company has instituted a new loose-leaf catalogue service. Starting with a section covering mechanical goods, additional information will be issued as it becomes available.

The mechanical goods section covers bullet-sealing; flame-retardant, hydraulic and other types of hose; lightweight air duct and flexible duct connectors; flexible tubes for boots, seals, chutes, etc.; rubber mountings and other rubber bonded-to-metal parts for absorbing vibration and shock; custom molded and extruded parts; aviation cements; packings; tubings; electrical wires and tape; battery separators; and other items used in military and naval aircraft.

The data are organized for efficient use by the design engineer. Government specifications are placed in juxtaposition with the items to which they refer. Considerable tabular data, charts, blueprints, and photographs are included. Distribution of this catalogue is being restricted to aircraft design engineers.

Suggested Airport Design

The Airport Dilemma—An Answer. J. O. Schulze. As a possible solution of the problem of reducing the length of runways needed for the steadily increasing size of present and future transport airplanes, a design is suggested for an airport of the future in which gravity is called upon to assist in the take-off.

The use of the catapult for this purpose is reviewed, but the writer finds certain disadvantages in the catapult which he states can be overcome by the use of an incline to take advantage of gravity as a means of acceleration. The suggestion is that these inclined runways be built in radial form, of which a detailed description is given, and ten advantages are cited. The suggested design also includes provision for hangars, repair shops and other usual airport facilities. *Iowa Transit*, December.

Time and Work Savers

Power of Suggestions. Al A. Adams. Several prize-winning ideas, submitted by Douglas employees for the improvement of production techniques, are described and illustrated. These include a portable pneumatic notching tool attachment, a combination broach-burnisher-dimpling tool, a cushioned bucking bar, and inner wing electric wire loom jigs. Other suggestions have resulted in the reduction of conventional production illustration perspective drawing of vanishing points to a simple mechanical procedure and the standardization of gas tank support gussets. *Douglas Airview*, November-December.

A Bell Aircraft Assembly Line

The Assembly Lines are Busy! There are 14 "stations" to a single Airacobra assembly line. This article gives some idea of the work that is done at each "station" and how parts and subassemblies are added according to one guiding plan until they emerge as an Airacobra ready for flight. *The Bell-ringer*, February.

Thermometer Bulletins

Wheelco Instruments Co., Chicago, Ill., has issued five new bulletins describing its line of industrial indicating, recording, and control thermometers.

Bulletin G23-2, of 12 pages, discusses the operating principle of Wheelco thermometers, and gives information to aid the user in selecting the proper instrument for his application. A table gives details on the characteristics, performance, and limitations of each class of vapor-pressure and gas-filled instruments. Similar information to aid in selection of bulb and socket materials and of capillary and its armor is also included. Available scales for indicating instruments and charts for recording instruments are illustrated.

Bulletin G503-2 covers the company's recording control thermometer, while G603-2 is on the Wheelco indicating control thermometer. Both bulletins, of 8 pages each, discuss the "electronic principle" of effecting control without mechanical contact between measuring and control sections of the instruments. Also described are program and proportioning thermometers, available in both recording and indicating types, and combinations of thermometers with the company's Flame-otrol, a combustion safeguard instrument. Schematic drawings are included.

Bulletin G303-2 describes and gives applications for the company's indicating thermometer, while Bulletin G403-2 covers its recording thermometer.

Comparison of Engine Types

Both Inline and Aircooled. Everard M. Lester. This is an attempt to present an impartial evaluation of the various current types of American aircraft engines that are now in volume production, the air-cooled radial type, the liquid-cooled in-line type, and the air-cooled in-line type. It is stated that since the sole purpose of any engine used for propulsion is the production of thrust horsepower the relative value of this power may be compared on the basis of total cost in dollars per thrust horsepower delivered as installed in the aircraft, including the initial purchase price of the engine, operating costs, overhaul and upkeep costs, and total life available from the unit. The writer does not attempt to derive mathematical formulas but confines the discussion to the major points.

Stating that design and development costs do not vary appreciably from one type to another, the writer sets forth the inherent problems in the design of the radial type and the in-line type, indicating that in both types there are advantages of one sort that are offset by disadvantages of another sort. Manufacturing cost is held to be the

most difficult item to evaluate in a comparison of different types of engine. Manufacturing cost is subdivided into fabrication cost and assembly and testing costs, consideration being given to each of these aspects, after which the writer gives an analysis of fuel economy, installed weight, installed drag, and propeller efficiency. Mentioning briefly the relative opportunities for the use of exhaust jet propulsion, the article makes comparisons on the basis of power developed per cubic inch of piston displacement, with regard to supercharger pressure and engine cooling at different altitudes. The advantages of the in-line air-cooled type are summarized and emphasized. *The Pegasus*, February.

Vacuum Pump Manual

The new Service and Maintenance Manual for Pesco Standard Vacuum Pumps and Related Accessories is intended to be a general guide for installing and servicing Pesco engine-driven vacuum pumps. It covers units built in three different sizes as follows: the 3P-194 Series having 7.0 cu.in. displacement, intended for suction only; the 3P-207 Series having 14.4 cu.in. displacement, intended for both suction and pressure; and the 3P-211 Series having 22.2 cu.in. displacement, intended for both suction and pressure. The first series is designed to furnish suction for the operation of flight instruments only, while the remaining types furnish suction for operating flight instruments and, in addition, provide pressure for operating anti-icing equipment of the inflated-tube variety.

The book is divided into sections covering descriptions of the different types, detailed explanations of Pesco vacuum pump design features, installation instructions and diagrams, principles of operation, lubrication, accessories, inspection and maintenance, overhaul procedure, test procedure, and causes and correction of difficulties. There are 47 illustrations, including photographs, drawings, and charts. *Pump Engineering Service Corporation*, Cleveland, O.

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PRECISION MEANS IN
BLACK & DECKER MOTORS

Every part properly designed... accurately made... to insure dependable motor performance under today's extremely severe operating conditions.

Here are some of the factors responsible for the important precision in Black & Decker motors: many years' experience in building all types of fractional horsepower, special application motors... high production standards... rigid inspection and testing... carefully trained personnel... efficient equipment.

Write and we shall be glad to send motor specifications for your file.

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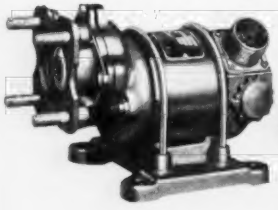


THOROUGH ENGINEERING is the basic factor behind the successful operation of this aircraft fuel pump motor and many other special application motors we have designed for all types of equipment.

BLACK & DECKER

★ SPECIAL APPLICATION MOTORS FRACTIONAL HORSEPOWER

Methods of Machining Plastics

Machining Laminated Plastics Efficiently. G. A. Ebelhare. Information is furnished on the efficient machining of laminated products made with Bakelite phenolic varnishes. Emphasis is placed on the importance of high surface speeds for drilling, turning and sawing these materials. It is explained that for the rapid and accurate fabrication of the many different items now being made for war purposes, in many instances machine tool speeds have been increased as much as 100 per cent. The writer describes production techniques developed and specialized machine tools used in the manufacture of the products. *Bakelite Review*, January.

Additions for Plywood Handbook

Two new sections have been made available for the handbook *Technical Data on Plywood*. The first section is a revised commercial standard on Douglas Fir, CS45-42. The information in the new commercial standard differs in several basic respects from the original Commercial Standard 45-40 and particularly refers to those involving grade descriptions and panel dimensions. The new section is to be filed immediately following Section I for ready reference.

Section V contains basic information on the insulation properties of Douglas fir plywood. *Douglas Fir Plywood Association*, Tacoma, Wash.

Origin of the Fortress Design

The Great Yankee Doodle. The evolution of the design of the Flying Fortress is traced back to its origin in 1934 in the office of the general manager of Boeing Aircraft. It is related that a conference was held upon the receipt

of Army Air Corps specifications covering bombers to be submitted in a forthcoming competition for Army contracts. Boeing experience in the designing of bombers is said to have originated in 1930. How the designers worked out their plans for meeting the Army's specifications is narrated.

The article goes on to describe how one problem after another was solved, encompassing the completion of the design of each component in turn and, finally, the complete plan for the airplane as a whole. *Boeing News*, January.

Vertical Turret Mills

A recent catalogue on Rogers "Perfect 36" vertical turret mills describes current models of these machines and their applications. It shows the particular features of these tools and the kinds of work they are designed to do. Condensed specifications of the standard model and the high-speed model facilitate selection to meet the requirements of users. *Rogers Machine Works, Inc.*, Buffalo, N.Y.

Machine Doctors

Beechcrafters Doing Their Part... As an example of the work done by the maintenance employees of Beech Aircraft Corporation, an account is given of how they repaired the dome of a 2,500-ton hydropress which had been pronounced "unrepairable." The repair procedure is outlined and resulting savings in time and money are reported. *Beech Log*, January 29, 1943.

Electric Contacts Manual

Fansteel Electrical Contacts—an Engineer's Manual is a 32-page booklet intended to be an aid to designers of electrical equipment and appliances. It contains notes on design for improved contact performance. Detailed descriptions are given of contact metals, alloys and powder-metallurgy compositions, together with a contact selector chart helping the designer to select the correct contact material for a given application. A wide variety of solid and composite rivets, screws, discs with projection backs for welding, plain and solder flushed discs and segments, bimetals and special service contacts are listed and illustrated. Included also are two pages of drawings and instructions detailing efficient and convenient assembly methods. *Fansteel Metallurgical Corporation*, North Chicago, Ill.

Airplane Starting System for Freezing Temperatures

P. & WA. Men Build Device to Start Wasps at '48 Below.' A practical method of starting airplane engines in sub-zero temperatures is announced. Some details are presented on this method, which was developed by Pratt & Whitney and is claimed to be 100 per cent effective. Using a simple apparatus built of elements that are readily available, the starting system unit is mobile and can be moved from one place to another with ease. No details are given. *Air-craft Journal*, January 20.

Production Control

An Airplane is Born. Palmer Wentworth. Part VI of a series of articles on aircraft production. This installment deals with production control. The writer tells how proper planning and scheduling assure a smooth flow of material on the assembly line. *Ryan Flying Reporter*, January.

Hand Roller for Taping

Hand Roller Cuts Taping Time in Half. To make work easier for women aircraft workers and other new employees and to improve efficiency and facilitate production, numerous ingenious devices and tools have been developed. One of these is a hand roller for applying finishing tape on fabric-covered airplane surfaces, used by Fleetwings. It is reported that the new tool cuts in half the time required by the former methods used, secures greater uniformity, and has other advantages. The former method of operation is described, along with the construction and operation of the new roller. It is stated that six tapes can be applied simultaneously by the use of the roller, compared with one tape by the hand method. *The Fleetwings' Arrow*, January.

Bulletin on AN Connectors

Revised to January, 1943, a loose-leaf booklet presents current information on Cannon plugs for aircraft applications meeting Army and Navy specifications. The uses of such connecting plugs, the features of their construction, and information on Army and Navy specifications are included, as well as illustrations and detailed descriptions of specific plugs meeting these requirements. The booklet comprises 82 pages and includes, in addition to the general information and tabular matter, pages on junction shells, AN cable clamps, dust caps, dummy stowage receptacles, and Cannon bonding ring. The Cannon catalogue condensed supplement is also included in a separate section. *Cannon Electric Development Company*, Los Angeles, Calif.

S.A.E. Aeronautical Standards

New sheets have been issued for inclusion in *S.A.E. Aeronautical Standards* files. They refer to horsepower correction formulas, airplane heating and ventilating equipment, temperature-control equipment, and propeller-hub cones and snap rings.

A new type of publication has also been developed to cover information that does not come under the classifications of aeronautical standards or recommended practices. These are to be known as *Aeronautical Information Reports*, of which No. 2 has recently been issued under the title "Airplane Heating and Ventilating Equipment Engineering Data." It consists of a compilation of data pertaining to heat-transfer coefficients, pressure losses in airplane duct equipment, and 21 miscellaneous figures for use in designing airplane heating and ventilating equipment and systems. Report No. 1, on "AN Standard Series" and related data, is expected to be made available in the near future. *Society of Automotive Engineers, Inc.*

Electronics

Electronics—A New Science for a New World is the name of a pictorial booklet issued by General Electric presenting the general story of electronics—its past, its present, and its possibilities for the future.

In the new booklet, accounts by word and illustration are given of how the electron is working in war combat to perform many marvelous functions; in research to reveal more of nature's mysteries; in industry to step up production, increase efficiency, and reduce material waste; in radio and television to extend the range and quality of sound and sight over the air waves; in agriculture to improve quantity and quality; and in medicine to reveal more and more of the structure and behavior of the human body.

Prefactory School

They're Paid to Learn. In an article on North American Aviation's in-plant training program, particulars are given about the preliminary shop training course. This course schools new shop employees in the fundamentals of handling basic tools for specific basic jobs. It provides them with related information necessary in the performance of their jobs and familiarizes them with essential procedures. Training periods last about three weeks, during which students receive regular starting-rate wages.

Some details are presented also on other phases of North American's educational program. Supplementary and supervisory training, machine-shop production training, engineering training, and education counselor services are listed as additional functions of their education division. *Skyline*, January.

WE HAVE
THIS TO SAY ABOUT
PLASTICS
Nothing that an aluminum man can have to say about plastics can add to their virtues or subtract from their very genuine possibilities.
Actually, Alcoa welcomes the strides being made, technically and commercially, by this great and ingenious industry.
This is not mumbo-jumbo. It is a distinctly pious thought.
The more folks who get the big idea that the bright hope of industry, postwar, is to do new things new ways . . . the more designers who really get down to cases, the better for all of us. Imagineering is a nationwide must.
Plastics do many things better than any other material.
Alcoa Aluminum does many things better than any other material.
The two can team up to do a better job for you in certain situations than either could do alone.
As for Alcoa Aluminum, busy seven days a week on war production, we can only remind you that when our strong alloys are again available, you are going to have to throw your old measuring sticks into the scrap heap. New costs, new strengths, new technology, new finishes.
Of such things will postwar jobs be made. On such things must our "eighth-day" thinking be concentrated.
ALUMINUM COMPANY OF AMERICA, 2104 Gulf Building, Pittsburgh, Pennsylvania.
Alcoa Aluminum
IMAGINEERING
ALCOA

. . . and we have this to say about METALS

This advertisement by a leading light metals producer talks good, common sense.

OBVIOUSLY, plastics are not going to put metals out of business—as some Sunday feature writers would have you believe. Both groups of materials are cast for leading postwar roles in what we all hope will be a bright new world. Both have their own, unique advantages.

Plastics, for example, are marked by high resistance to chemical and atmospheric attack. They are light. They have excellent electrical insulating values and many desirable thermal properties. They offer a range of integral colors practically as wide as the spectrum, and many forms are transparent, translucent or opaque as the customer specifies. They can be molded into intricate shapes that require little, if any, finishing. They are warm and friendly materials to touch.

On the other hand, no molded plastics have yet been developed that equal metals for surface hardness, heat resistance, rigidity or structural strength per unit of area. Conventional molding methods require expensive molds and high heat and pressure limiting them to production of relatively small objects in relatively large quantities.

In short, there will be many a postwar job where metals will be a clear and obvious first choice.

There will be many other postwar jobs which logically call for plastics.

There will also be many occasions when plastics and metals will work together on the same job.

And there will be other times when a materials engineer will be hard put to make a choice.

Frankly, as one of the nation's largest producers of plastics, Monsanto would rather lose some of those close decisions than win a job which plastics could not handle. In the long run, one such misapplication can lose more business for plastics than losing a dozen close decisions. MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield, Massachusetts.

☆ ☆ ☆

MONSANTO PLASTICS
SERVING INDUSTRY . . . WHICH SERVES MANKIND

THE FAMILY OF SIX MONSANTO PLASTICS

(Trade names designate Monsanto's exclusive formulations of these basic plastic materials)

LUSTRON (polystyrene) • **SAFLEX** (vinyl acetal) • **NITRON** (cellulose nitrate) • **OPALON** (cast phenolic resin) • **FIBESTOS** (cellulose acetate) **RESINOX** (phenolic compounds)

Sheets • Rods • Molding Compounds Tubes • Castings • Vuepak Rigid Transparent Packaging Materials

From the Industry

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.

Supercharger Intercooler

A 4-page pamphlet describes the general functions and need for intercoolers and offers specific data on the intercooler manufactured by the Airesearch Manufacturing Company, Los Angeles, Calif. This product is of tubular construction made entirely of heat-treated, corrosion-resisting aluminum alloys. Its tubes are mechanically joined to headers and support plates and are jig-assembled for accurate control of dimensions. Designed to specific airplane requirements, the Airesearch intercooler is said to meet the problems of weight, volume, cooling efficiency, structural soundness, and freedom from maintenance trouble.

Aircraft Radio Relay

The Model AK relay for aircraft control equipment is designed to provide magnetic holding pressure on both transmission and receiving contacts. One pole is equipped with two windings: one is a holding winding connected directly across the battery supply; the other winding is connected in series with the single winding on the other pole and is polarized so that when the circuit is completed through the key the flux is neutralized on the holding or "receive" position pole and the armature pulls up to the "transmit" position. Opening the key cuts off the buckling flux, and the holding flux pulls the armature back to "receive" position.

The AK relay has a contact rating of 1,000 volts at 30,000 ft., 20 megacycles; it is 4-pole double-throw; it is insulated to sustain 10,000 volts at sea level; its standard models are in 10 and 24 volts d.c.; its wattage consumption is 5.5 in first position and 17.0 in second position. Dimensions are $2^{7}/_{16}$ by $3^{1}/_{2}$ by $2^{1}/_{4}$ in.; its weight is 17 oz. Allied Control Company, New York, N.Y.

Universal Check Valve

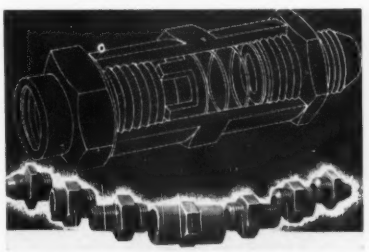
A new type universal check valve that allows twelve combinations to be made with one body and any two of three types of adapters is now in production at the American Screw Products, Los Angeles, Calif., under the trade name "ASP." Designed primarily for installation in airplane hydraulic lines, the ASP valve is claimed by the manufacturer to be light and to have a large flow capacity with corresponding reduction in back pressure.

A phenolic poppet seats at either end of the valve body. Adapters are available for flared tubing or external and internal pipe threads. Made in all standard tubing sizes of heat-treated aluminum alloy, a standard body can be assembled with two of three types of adapters to meet the requirements of any combination of tubing or pipe connectors or direction of fluid flow.

It is claimed that laboratory tests to 50,000 reciprocations at variable temperatures up to 275°F. have developed no breakdown or distortion. The valves are manufactured to Army Air Corps, AN, and Navy specifications.

New Flat-Type Aircraft Engine

The Lycoming Division of The Aviation Corporation, Williamsport, Pa., recently announced a new Lycoming flat, geared engine identified as the GO-435. It is a six-cylinder, horizontally opposed engine of 210 hp. with a planetary-type reduction gearing. The gear ratio of 77 to 120 provides a propeller speed of 1,925 r.p.m. at the rated crankshaft speed of 3,000 r.p.m. The gear unit is self-contained and is assembled on the forward face of the crankcase. The propeller thrust is taken on a ball bearing on the propeller shaft.



American Screw Products universal check valve.

Because of its compactness the new geared engine is said to be readily adaptable to streamlining and submerged installations, such as the proposed family plane of the future might utilize. The engine is designed to use 73-octane fuel.

Speedy Assembly Work

Rapid and expert work is required in the assembly of functional parts to cast aluminum cylinder heads heated to 650°F. Within the space of 76 seconds, the Lycoming workers on the assembly line perform a dozen different operations, including the insertion of bronze intake and exhaust valve seats, install and seal sparkplug bushings, insert the molybdenum-steel forged cylinder barrel, place intake and exhaust valve guides, and drive in the steel rocker-arm bushings. All this is completed in less time than it takes for the heated cylinder head to drop 15° in temperature. The completed cylinder unit is water-tested under water pressure of 150 lbs. per sq. in. Lycoming Division of The Aviation Corporation, Williamsport, Pa.

Electric Tools in Industry

A pamphlet has been issued telling how Black & Decker and Van Dorn portable electric tools are being adapted to emergency war uses. Some of the unusual uses that are being made of portable electric tools in war production are recorded. One example is that of a manufacturer of welded structures for airplane supports. Lacking available machine tools, Black & Decker portable drills were placed in clamping devices and were found satisfactory for the work. This pamphlet contains 17 pages and is illustrated. Black & Decker Manufacturing Company, Towson, Md.

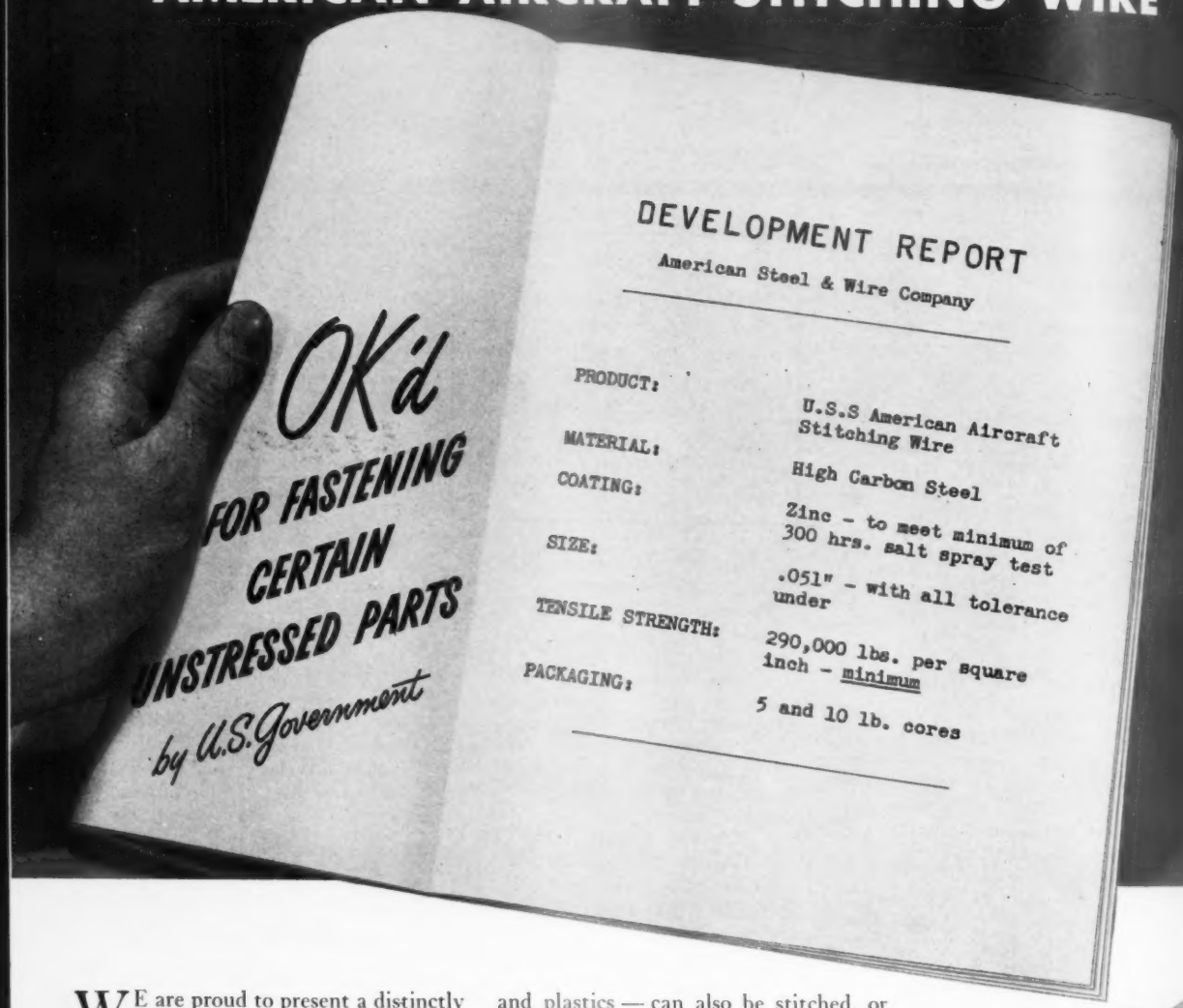
New Aluminum Refining Facilities

Bohn Aluminum & Brass Corporation, Detroit, Mich., has announced the formation of a new division to be known as Aluminum Refiners Division of the Bohn Aluminum & Brass Corporation, which will specialize in the refining of aluminum scrap into aluminum alloy ingot.

The formation of the new division is

Announcing

AMERICAN AIRCRAFT STITCHING WIRE



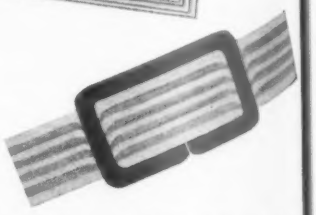
WE are proud to present a distinctly new "tool" for increasing speed and cutting costs on the production front—a new stitching wire developed especially for aircraft manufacturing by which parts such as heat ducts, trailing edge beading, junction boxes, ammunition boxes, ejection chutes and other unstressed units can be more quickly fabricated.

With U·S·S American Aircraft Stitching Wire, stainless steel, carbon steel, aluminum and other metals—in gauges up to .035″ for stainless steel—up to .060″ for SO aluminum, and .040″ for 24 ST aluminum—can be fastened together, at high speed, economically and with unskilled labor.

Other materials—wood, leather, fabric and plastics — can also be stitched, or stapled, to metal by this simple, time-saving means. "Sandwiches" of these materials in steel or aluminum can also be made up to ¾″ thick.

American Aircraft Stitching Wire is heavily coated with a tightly adhering zinc coating which renders it corrosion resistant to a high degree. Samples have come through salt spray tests in excess of 300 hours with flying colors. Staples have been successfully tested both for shearing strength and vibration fatigue.

If you want to save time and conserve strategic materials—this method of fastening certain unstressed airplane or glider parts will be of definite interest to you. We shall be pleased to discuss further details at your convenience.



This section (twice natural size) **illustrates the** tight corners and full **bearing of** wire against material **made possible** by use of **AMERICAN AIRCRAFT STITCHING WIRE.**

AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Export Company, New York

UNITED STATES STEEL

intended to centralize in one plant the recovery processes heretofore distributed among the various fabricating plants of the corporation. The generation of large amounts of aluminum scrap in the plants making castings, forgings, and extrusions has outgrown the individual plant facilities and the new unit will permit large-scale operation In addition, the new division will be in a position to aid the war effort further by refining quantities of scrap now being accumulated in engine, airplane, and other factories.

Aircraft Plastic Prevents Sunburn

The Celanese Celluloid Corporation announces that a special formula has enabled their Aero Quality Lumarith transparent aircraft plastic to screen out the severe sunburn-producing ultraviolet rays.

It is reported that on long bombing flights at high altitudes behind acrylic type plastics, aviators have returned seriously burned. Though some reddening of skin is possible, it is claimed that painful or harmful sunburn will be greatly minimized behind windows of Aero Quality Lumarith. This transparent cellulose acetate-base plastic is said not to transmit the rays that cause sunburn.

Cessna Training Planes

It is reported that 1,000,000 miles a day are being flown in Cessna bomber-pilot training planes at U.S. Army and Royal Canadian Air Force flying fields.

Built with a steel tubing fuselage and plywood wings, fabric-covered, the two Cessna models—the Bobcat, or AT-17, of the U.S. Army, and the Crane of the R.C.A.F.—make a minimum use of strategic materials vital to the construction of combat aircraft. This type of construction is also said to facilitate speed, economy, and simplicity of maintenance. Cessna Aircraft Company, Wichita, Kan.

New Manganese Alloy

A new manganese-base alloy is introduced as Chace Manganese Alloy No. 772. Its distinguishing features are said to include improved design and performance possibilities for instruments and industrial controls. It is claimed that over 70 per cent of this alloy is manganese. This high manganese content and the resulting physical properties are made possible by the use of electrolytic manganese of a purity higher than 99.9 per cent.

The useful characteristics claimed include: (1) a high electrical resistivity, (2) a high thermal expansion rate, (3) a high vibration damping constant, and (4) a low thermal conductivity combined with good ductility and high tensile strength. The electrical resistance is 1,050 ohms per circular mil foot. The thermal expansion rate is about twice as high as for steel. The vibration damping constant is 2.3 per cent compared to 0.01 for hardened steel. The thermal conductivity is only 2 per cent of the value for copper.

The high electrical resistivity, low temperature coefficient of resistance, and excellent physical properties are a combination that makes the alloy suited for such low temperature resistor applications as rheostats, auxiliary heaters for circuit breakers, and electrically heated expansion elements. The use of the high thermal expansion rate of the alloy has resulted in greatly improved thermostatic bimetals and offers the same possibilities for other types of differential expansion mechanisms. Advantage is being taken of the low thermal conductivity for parts of soldering irons, circuit breakers, and other equipment in which heat barriers can be used. The alloy, it is stated, can be readily fabricated by the usual rolling, drawing, and machining operations and is available in the form of sheet, strip, and rod. A published data sheet covers physical properties and commercial applications. W. M. Chace Company, Detroit, Mich.

In 76 seconds, workers at the Lycoming Division of The Aviation Corporation install essential parts in a cast aluminum cylinder head heated to over 650°F. Over a dozen different operations must be made before the cylinder head has been cooled 15°.

New "Tap" Screw

The Continental Screw Company, New Bedford, Mass., has patented an innovation in metal-to-metal and plastic fastenings which incorporates new features to eliminate the difficulties encountered in applying and driving self-tapping screws.

A smooth pilot point below tapered threads automatically effects a self-aligning and holding action when the screw is applied. Securely fitted in the hole to be tapped, this new "Tap" screw is claimed to cut threads accurately in correct alignment as it is driven in. When screws have to be driven at an angle or upside down, this smooth pilot-holding and aligning feature is said to save time, prevent lost screws, and effect accurately cut threads in proper alignment.

Another improvement consists of a complete slotted opening at the entering end of the screw. This slot produces a self-cutting edge that closely simulates the cutting action of a tap and insures quick, easy, and accurate tapping or self thread-cutting action.

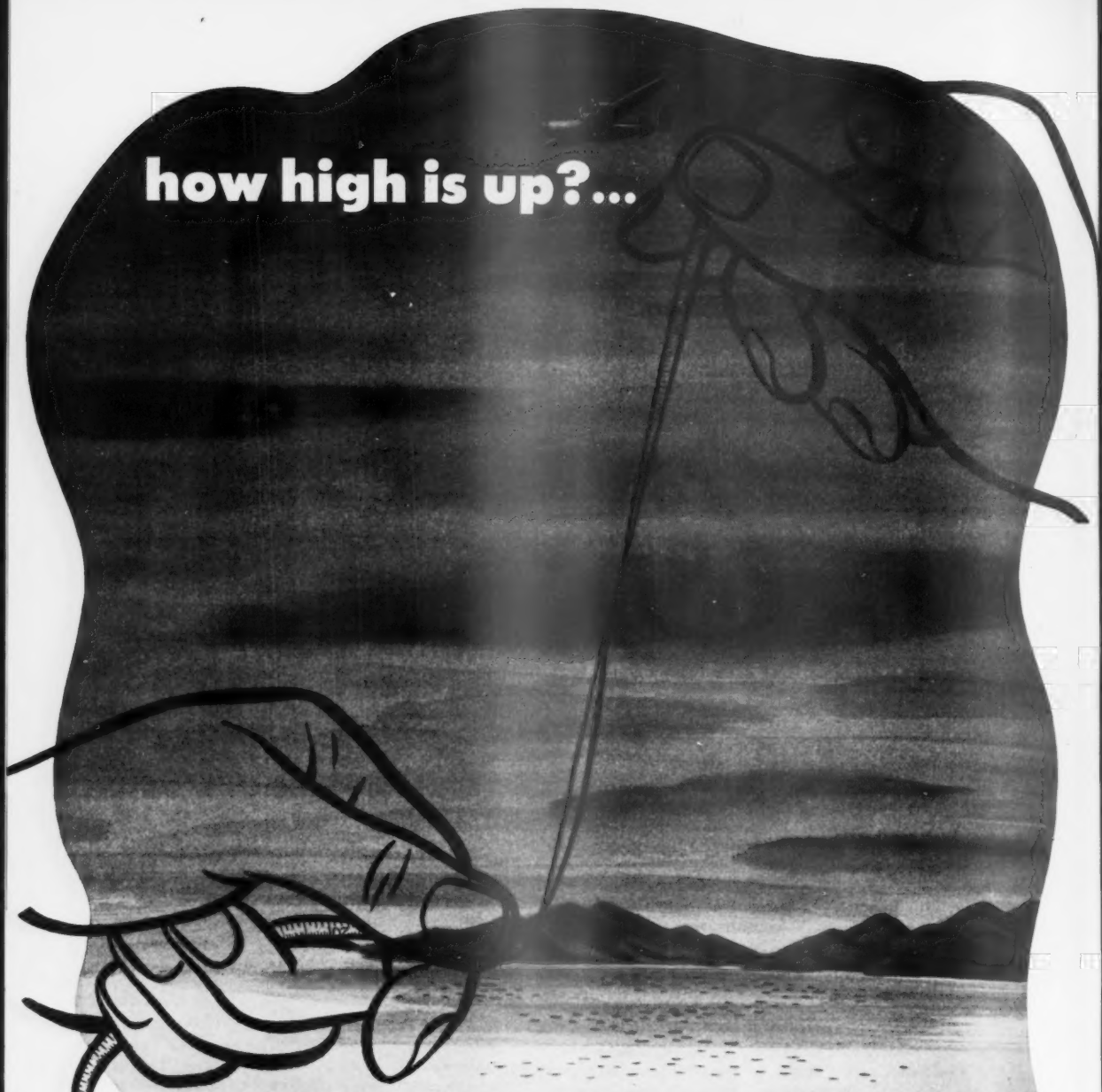
When provided with Phillips recessed heads, these new "Tap" screws are claimed to cut fastening time. Eliminating the necessity for separate tapping operations by self-cutting a mating thread in the material, this screw is said to remain tight under the loosening action of vibration.

Army Version of the Helldiver

Delivery of the first of a new dive-bomber type to the U.S. Army Air Forces by the Curtiss-Wright Corporation's Airplane Division, was made recently.

Designated as the Curtiss A-25 the new dive bomber is an Army version of

how high is up?...



Knowing where you are is extremely important when you're trying to bring a plane to a fixed destination and land it gently through fog and rain. Vacuum tubes, the heart of radio, provide the answer to this problem. ★ Dependability, stamina and outstanding performance capabilities are perhaps more important to aircraft radio communications than for any other service. It is no mere coincidence that Eimac tubes were selected by practically every major airline in the U.S.A. In actual performance, Eimac tubes have established themselves as the leader in this field—the tried and proved tube for aircraft ground stations. Remember that next time you take off. And be assured that the communications system that helps get you there is equipped with the only vacuum tubes unconditionally guaranteed against premature failures due to gas released internally.

EITEL-McCULLOUGH, INC., SAN BRUNO, CALIFORNIA, U.S.A.

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the Curtiss (SB2C-1) Helldiver, now being produced for the U.S. Navy. The A-25 is a two-place, mid-wing monoplane powered with a 1,700-hp. Wright Cyclone engine and equipped with a Curtiss electric propeller and retractable landing gear. All details of its speed, armament, cruising range, and bomb-carrying capacity are military secrets.

It is said that the current A-25 design is so similar to the Navy model that, with minor changes that can be made in the field, the plane can be utilized by either service.

Improved Automatic Stamping Press

Variable speed control between 180 and 550 strokes per minute to suit various punching requirements, arrangement for addition of spacers to provide a die space to $5^1/_4$ in., and provisions in the ram to permit boring it out for punch shanks to $1^9/_{16}$ in. are now included in the Diebel Hi-Speed stamping press.

The Diebel press will take die sets measuring up to $6^1/_4$ by 8 in. The press includes an integral roll feed for strip stock up to $4^1/_2$ in. in width. Drive is by a $^3/_4$-hp., 1,140 r.p.m., 60-cycle three-phase motor mounted under the bed. The head design includes a cylindric ram measuring 4 in. in diameter and an inserted pitman screw.

The bronze pitman faces upward and carries a steel screw that engages adjustment nuts on the two sides of a 1-in. steel crankpin assembled in a head that connects by four studs to the cylindric ram. The stock feed is driven by an adjustable crankwheel on the end of the crankshaft. The wheel operates a reciprocating rack and a one-way mechanism connecting to the 3-in. feed rolls. Bronze bearings are used throughout.

The Diebel press occupies a floor space of 20 by 32 in. It is 54 in. high, weighs approximately 500 lbs., and has an approximate rating of 5 tons. Di Machine Corporation, Chicago, Ill.

Anchor Nut and Metal-to-Metal Riveting

The use of Dill Lok-Skrus for anchor nuts and for metal-to-metal riveting is said to afford a speed of application that is as much as 30 times faster than that obtained in other ways.

Originally developed in cooperation with commercial and military aircraft engineers, Lok-Skrus require only one drilled hole. Mounting is a one-man operation with either hand or power tool. The Dill Manufacturing Company, Cleveland, O.

Windshield Improvements

An aircraft windshield that will protect pilots against collisions with birds in flight and against the accumulation of ice is anticipated as a result of a development program carried out by the Civil Aeronautics Administration and a group of manufacturing companies during the past year.

The research was directed by John Easton, Chief of the C.A.A. Technical Development Division, and by A. L. Morse, Chief of the Aircraft Development Section of that division. Engineers of the Pittsburgh Plate Glass Company and Libbey-Owens-Ford Glass Company prepared the glass and did the laminating, while technical experts from E. I. du Pont de Nemours & Company and the Monsanto and other chemical companies provided plastics.

Deicing experiments have been carried out by the personnel of the National Advisory Committee for Aeronautics, by aircraft manufacturers, and by the domestic air lines. The bird-testing program is being undertaken by the C.A.A. at the East Pittsburgh plant of the Westinghouse Electric & Manufacturing Company.

The glass and plastic manufacturers have produced a new type of plastic glass windshield assembly that offers a high degree of protection. Panels having reasonable weight and optical characteristics have been developed which will withstand the impact of 15-lb. bird carcasses at speeds in excess of 200 m.p.h.

The specimens are projected against test windshields by a large air gun developed by the Westinghouse company. Velocities in excess of 400 m.p.h. can be attained.

One type of panel is made by laminating a sheet of especially prepared "Butacite" polyvinyl acetal resin $^1/_2$ in. thick between two panes of semitempered glass, each $^1/_8$ in. thick. The amount of plasticizer used is adjusted to provide a maximum of toughness and "give" at the temperatures maintained during flight. The $^1/_2$-in. plastic sheet extends about an inch beyond the glass and is bolted to the reinforced metal framework of the airplane. Sheet metal strips are imbedded in these extended edges to insure against the windshield's tearing loose from the supporting structure. The hazard of flying glass is eliminated by substitution of a scratch-resisting plastic for the rear glass plate.

The windshield assembly includes a front pane of $^1/_4$-in. tempered glass, separated from the impact-resistant panel by a narrow air space through which hot air can be circulated. This prevents the accretion of frost and ice and maintains the high temperatures necessary to provide a maximum of impact resistance in the bird-resistant panels. E. I. du Pont de Nemours & Company, Inc.

Bearing Plating

In the production of silver-plated bearings for airplane engines the rate of plating is more than trebled by use of potassium cyanide, formerly imported from Europe but now made in this country by the Electrochemicals Department of E. I. du Pont de Nemours & Company.

Potassium salts now are recovered by recrystallization from the vast Searles Lake salt deposits in the desert country of California. These salts provide the basic material from which potassium cyanide is manufactured at a nearby plant of the du Pont company.

In an electroplating bath, potassium cyanide not only increases the rate at which silver plate is deposited on the engine bearings but also gives required heavier coatings that are said to be smooth, firmly adherent, fine grained and easily machined or burnished. Coatings of silver deposited on the bearings, some of which are 3 to 4 in. in diameter and range from $^3/_{100}$ to $^5/_{100}$ in. in thickness, whereas silver electrodeposits usually are measured in thousandths of an inch.

Potassium cyanide also is used in copper plating of war materials and as a nitriding agent in the surface hardening of tool steel.

Data on Plastics

Engineering Highlights About du Pont Plastics is the title of an 8-page bulletin containing information on the applications of these plastics and their general properties. It contains tabulated data covering the general properties of Lucite methyl methacrylate resin and Plastacele cellulose acetate plastic. Other products covered in a similar manner are Pyralin cellulose nitrate plastic, Nylon monofilaments, and Butacite polyvinyl acetal resins. Definitions of the properties of plastics are set forth. E. I. du Pont de Nemours & Company, Inc., Plastics Department, Arlington, N.J.

Magnesium Furnaces

A bulletin on magnesium melting and alloying furnaces has been issued by the Fisher Furnace Company, Chicago, Ill. Designated as No. 500, this bulletin contains 12 pages and is illustrated. It describes the types and sizes of furnaces manufactured by this company, including the recently produced MAH furnace built to accommodate a 4,400-lb. charge in magnesium alloy.

Fusion Production Alloys

The first part of an engineering handbook on silver brazing and soldering has been put out by Fusion Engineering, Cleveland, O. Additional loose-leaf pages will be furnished from time to time. Among the items listed are low-

UNCENSORED
REPUBLIC P-47
THUNDERBOLT
SPEED . . . . . 400+ m.p.h.
DIVE . . . . . 725 m.p.h.
CEILING . . . . . 40,000 ft.
ENGINE . . . . . 2,000-h.p. radial
PROPELLER 4-blade
FIREPOWER . . . . 8 50-cal. guns

The Axis Knows!... The cunning minds of the Luftwaffe and the Kokutai know to a certainty that *Republic P-47 Thunderbolt* squadrons can annihilate opposing formations. They're *not* happy about these high-altitude blitz-busters of the U. S. Air Forces!

REPUBLIC AVIATION

REPUBLIC AVIATION CORPORATION REPUBLIC AVIATION FARMINGDALE, L. I., NEW YORK

and high-temperature solder alloys, silver brazing alloys, brazing and welding fluxes, and miscellaneous fusion products. The fusion process is explained and methods of application for fusion alloys are outlined.

Electronic Welding Control

A new electronic half-cycle, synchronous control for the precise operation of resistance-welding machines has been announced by the General Electric Company. Mounted in a protecting cabinet, the control is furnished in two types: the CR7503-A136, which also includes a welding transformer and is designed for bench mounting, and the CR7503-A133, which is without a transformer and is designed for wall mounting. Both types can be used either with tongs or with a suitable bench welder.

The control features a new tube, the easily replaced GL-415; a new circuit intended to make higher-speed welding possible; and a simplified initiating circuit that improves performance and reduces maintenance. The new design also incorporates heat control by the phase-shift method. The heat adjustment is made by a dial mounted on the front of the cabinet.

The control is said to facilitate the welding of tinned copper, steel, or alloy wires; of studs from 0.01- to 0.05-in. diameter to flat surfaces, with little or no indentation on the opposite surface of the metal; and the spot welding of unusually thin (less than 0.01 in.) pieces of stainless or mild steel, nickel, or silver to brass or bronze, with negligible oxidation or discoloration.

The control also makes possible the welding of low-resistance joints that are unaffected by temperatures considerably in excess of 125°C., the point at which certain types of soldered joints weaken and often collapse. This results in the elimination of solder, with a corresponding saving of tin and a saving of approximately 50 per cent in time. Also, in many cases it simplifies the problem of training new employees.

Simplified construction is one of the several important features that characterize a new electronic capacitor discharge resistance-welding control announced by the General Electric Company for the resistance welding of aluminum. This construction not only eliminates much vital material but facilitates thorough inspection and servicing.

Employing the energy-storage principle, the new control is said to perform effectively the functions for which a control of this type is designed. The control consists of a charging circuit, a discharge circuit, control station, Pyranol capacitors, and sequence control. All this equipment is mounted in one cabinet-type, G-E industrial control enclosure with full-length front doors and removable rear covers. The enclosure is ventilated by filtered air which, drawn in by a blower, creates a positive pressure within the cabinet and so minimizes the infiltration of dust and dirt. The main anode transformer and all tubes requiring cooling are air-cooled by a ductless system.

The charging- and discharge-tube circuits are mounted on a single, hinged compound base that can be swung out readily for servicing. The control station—consisting of the capacitor selector switch, voltage-adjusting potentiometer, sequence adjusters, voltmeter, control switches, and indicating lights—can be removed from the cabinet and attached to the welding machine. With this arrangement, the control cabinet can be located on a balcony or some other remote point.

Rivet-Sorting Machine

A new rivet-sorting machine that is resulting in a daily saving of hundreds of thousands of rivets, many of them made of aluminum, has been developed by Fisher Body Division of General Motors. The new machine is said to have virtually eliminated rivet wastage. It not only makes a daily saving in critical materials, but it makes salvaging of rivets an economically feasible undertaking.

In the Fisher aircraft plant more than 40 different types of rivets are used each day. In addition to aluminum rivets, there are steel, copper, and iron rivets. For each head type there may be rivets of many varying lengths, so the result is an assortment of more than 220 lengths of rivets varying according to head type and material type.

The machine is in reality a battery of four machines. Each has a primary selector that is a perforated, revolving cylinder. The perforations in each of the cylinders are of different sizes, so that rivets that fall through from each of the four cylinders are grouped according to thickness, regardless of their length or head type. The cylinders are interchangeable, so that there is one cylinder to fit every rivet thickness being used in the plant.

After they have been sorted according to thickness, the rivets are dropped into a hopper from which they are carried on a pronged trough to the next selection operation. At the bottom of the trough the rivets, with their heads upward, reach a flat, disclike selector that is notched and revolves constantly.

Each rivet slides into one of the notches. Then, as the selector turns, the various head types are kicked off by the selector arms. If the machine is set for selection of round head rivets, all other types are kicked off into a container, the round head rivets continuing on for selection as to length. Then the selector is set for flat head rivets, the remaining types are kicked off, and the flat head rivets are sorted according to length, and so on.

Then comes the third and final phase of the operation—sorting the rivets according to length. Extending from the circular selector are a dozen or more small channels. As it revolves, needles kick out the rivets according to their individual lengths. This completes the sorting process, first according to thickness, then head type, then length. The machine now is being operated two shifts daily at the Fisher aircraft plant, and its average output is 200 lbs. of sorted rivets per day.

Rubber Engine Mounts

The Goodyear Tire & Rubber Company has announced that new flexible aircraft-engine mounts to cushion the engines on rubber are being adapted to Army training planes.

Tests are under way by the U.S. Army Air Corps, it is said, to enable the use of another cushioning method, but following the same principle, for the engines of heavier military planes.

It is reported that the rubber cushioning for the engines will extend the plane's usefulness because of lessened vibrational stress, provide greater fire precision and more accurate aiming of bombs, and reduce vibration-inspired nervous strain on pilots. The rubber engine mounts for the training planes are expected to go into quantity production within a short time. Quantity production is also expected on the large-engine type of mounts after tests are completed.

Chemigum for Aircraft Hydraulics

Another adaptation of synthetic rubber to the control mechanism of military and commercial airplanes is being worked out in the application of Chemigum for use in aircraft hydraulic accumulators. It is said that engineers have perfected a Chemigum of sufficient flexibility and resilience to warrant the replacement of other types of compounds for this purpose.

The synthetic-rubber diaphragm within the accumulator separates the air, by which pressure is exerted, from the reserve fluid supply. Chemigum is said to be suitable for these diaphragms because of its imperviousness to the fluid used in the hydraulic systems of military and commercial airplanes.

Production of synthetic rubber packings, sealing rings, and other parts in the hydraulic control systems of airplanes has already been accomplished. Goodyear Tire & Rubber Company, Akron, O.

This Year Rubber Is Tapped from Test Tubes

Synthetic Rubber Already Is Working for Users of Mechanical Rubber Goods

War production is up threefold. But the vital rubber stock pile is dwindling fast. This is the year of crisis in rubber.

There is only one solution . . . the production of synthetic rubber in steadily increasing tonnages . . . synthetic rubber to take over jobs once handled by natural rubber . . . to perform new tasks, serve in new applications created by wartime need.

One of the first synthetic rubber plants in the Government's program was built and is being operated by United States Rubber Company . . . another soon will be in production.

Our engineers have been working with synthetic rubber since 1921. During this period they have learned that no one synthetic should be used for all types of mechanical rubber goods. They have found where and how synthetic is superior to natural rubber, where it is equally as good, where it falls short. They know what uses each of the five basic commercial types of synthetic rubber is best suited for — Neoprene, Buna-S, Buna-N, Butyl, or Thiokol—and how to compound the specific synthetic rubber for the specific task. U. S. Rubber has used all five types and knows which one to select for the performance required.

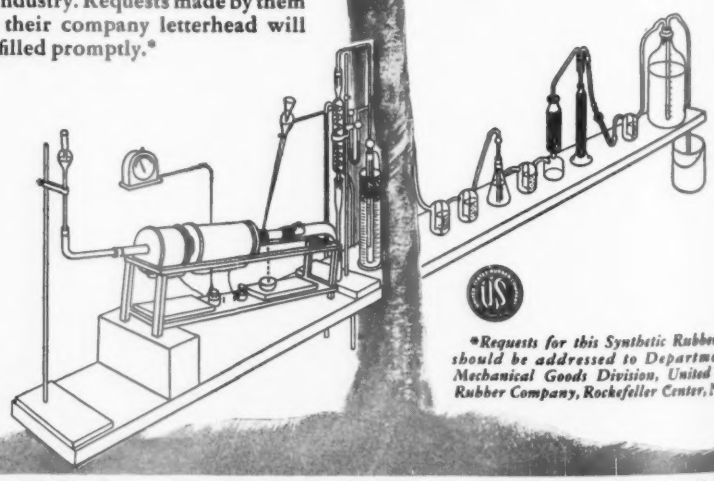
Information based on the results of vast experiments and practical applications of synthetic rubber has been incorporated in a new comprehensive book, *The Five Commercial Types of Synthetic Rubber.*

This informative book traces the history of synthetic rubber from the earliest experiments of Michael Faraday to the present. It discusses each of the basic types of synthetic rubber, tells where it has been used successfully in United States Rubber Company products, and compares its properties with natural rubber. It tells how synthetic rubber is made. It is a detailed answer to the most vital question of the day.

We feel that *The Five Commercial Types of Synthetic Rubber* is a publication of real importance to men of industry. Requests made by them on their company letterhead will be filled promptly.*

The successful use of synthetic rubber in mechanical rubber goods and the insurance of fully dependable service depend largely upon the skill of the manufacturer and compounder. Each of the five basic commercial types of synthetic permits a myriad of variations.

The United States Rubber Company has been developing and improving rubber products for one hundred years. Today, the same vast resources for research and development that resulted in some of the most spectacular achievements in the rubber industry are being devoted to the problem of synthetic rubber. A great backlog of knowledge already has been built. More is being constantly added.



**Requests for this Synthetic Rubber Book should be addressed to Department M Mechanical Goods Division, United States Rubber Company, Rockefeller Center, N.Y.C.*

UNITED STATES RUBBER COMPANY

Mechanical Rubber Goods Division • Rockefeller Center • New York

In Canada, Dominion Rubber Co., Ltd.

Pilot Light Assemblies

A bulletin, perforated for inclusion in a loose-leaf binder, covers an extensive range of types and sizes of pilot-light assemblies, giving dimensions and other descriptive information. In addition to the standard models, the manufacturer states that special assemblies are designed and built to meet specific requirements. Gothard Manufacturing Co., Springfield, Ill.

Arctic Shelters

The Army Air Forces recently awarded to the James Manufacturing Company, Fort Atkinson, Wis., a contract for an undisclosed number of a new type of lightweight, portable shelters for use by Air Forces personnel in Arctic climates.

The shelters are specifically designed to save weight, to occupy a minimum of space when packed for shipment, and to reduce the amount of fuel that must be shipped to heat them by incorporating blankets of glass fiber insulation in the walls and flooring. When packed for shipment, they are sufficiently light and compact to permit transportation of the complete unit by air.

Of impregnated cotton fabric and laminated wood frame construction, the shelters, when erected, are 16 ft. in width by $8\frac{1}{2}$ ft. high in the center. They may be used in any 8-ft. multiple of length. They are heated by gasoline heaters.

While the Fiberglas insulation weighs only about 200 lbs. for a 16 by 16-ft. shelter, it is estimated that it will reduce from 27,360 to 6,790 lbs. the weight of the fuel that must be transported to maintain in each shelter throughout the heating season a temperature in which men can live comfortably. The total weight of each such shelter is approximately 1,200 lbs.

The James Manufacturing Company's new type portable shelter for use by Army Air Corps personnel in Arctic climates. Blankets of glass fiber insulation in the walls and flooring are said to save more than 20,000 lbs. in the weight of the fuel that must be transported to maintain in each shelter, throughout the heating season, a temperature in which men can live comfortably. The shelters can be transported by air.

New Aircraft Connector Link

A new engine cowl ring connector link for aircraft is said to embody two new and improved features. It incorporates a rubber bushing that absorbs engine and flight vibration, together with a simple rocker arm action or compensating principle that takes up normal engine heat expansion. These features are claimed to make possible a flexible, virbration-absorbing link of unusual strength that will eliminate split cowling failures caused by excessive vibration transmitted from the engine to the cowling.

Being molded of aluminum alloy, the new Kinney link is well adapted to quantity production. Heat-treated under continuous metallurgic control and X-ray tested, the Kinney link was designed to meet static and strength requirements. It has an anodized finish and is completely machined and assembled. Kinney Engineering Company, Los Angeles, Calif.

Chemically Neutral Heat-Treating Furnace

Said to be the largest chemically neutral atmosphere furnace yet built, a Lithco heat-treating furnace is operating in the eastern plant of one of the large propeller manufacturers.

Many problems were overcome in designing this Lithco equipment. The muffle had to be designed to withstand working temperatures ranging from 900° to 2,100°F., depending upon the requirements. A rail-roller system of support for the muffle was evolved to facilitate compensation for expansion and contraction. Sixty-six specially designed burners were required to insure even heat distribution through all areas of the muffle. The capacity of the furnace approximates 3,000 lbs. per hour. Overall dimensions are 8 ft. wide, 10 ft. high, and 30 ft. long.

This furnace has no atmosphere adjustments, and none is required to obtain uniform decarb-free hardening, regardless of the steel heated. The chemically neutral atmosphere nullifies any contaminating influences such as furnace gases, included moisture, occluded moisture on the work, water vapors, etc. Thus clean, bright work is obtained at all times, without cleaning, polishing or descaling operations. Protection is afforded when the work is removed from the furnace; no scaling or decarburization occurs when work is air-cooled. Lithium Corp., Newark, N.J.

Semiautomatic Work Feeder

A new semiautomatic fixture for feeding and holding work while drilling and tapping operations are performed is announced by Mead Specialties Company, Chicago, Ill. This fixture, known as the "Disc-Feeder," reduces the work-handling time involved in a variety of drilling and tapping operations. It was designed to feed, hold and eject work pieces within its capacity at the rate of 3,000 to 5,000 per hour, depending upon the size of the work and allowing for the time spent actually drilling, tapping, or otherwise machining the work piece.

The Disc-Feeder is not limited to round work pieces; it can handle flat stock of a variety of shapes such as squares, rectangles, ovals, and irregularly shaped blanks. One or more drill bushings can be mounted above the work where desired. Almost any shape of flat work pieces can be handled by suitable adaptation of the hopper-ways. The fixture can be quickly adjusted to accommodate work varying from approximately 1 to 3 in. diameter (or 3 in. across the widest portion). The range in thickness is variable from a minimum of approximately $\frac{1}{8}$ in. to a maximum of approximately $\frac{3}{4}$ in. By means of special attachments, small cylindric work can be handled as readily as flat pieces, such as certain second operations on screw-machine products.

By removing the hopper the Disc-Feeder can be equipped with ordinary flat jaws for use as an air-operated, hand-fed drill press vise. The standard ram and anvil are heat-treated and provided with V-notches to center the work and are serrated to hold the work securely. A variety of shapes can be held by removing the standard ram and anvil and substituting jaws or bushings specially formed to fit the work. The hardened ram is removably attached to a platform that slides on dovetail ways into the body of the fixture. The hardened anvil is removably attached to the upper surface of the fixture body that is machined parallel to the base of the fixture. The Disc-Feeder is operated by a foot-control valve that changes the work when the pedal is pressed and holds it in position for machining until the pedal is pressed again.

New Metallizing Process

Metallizing Engineering Company, Inc., has announced the new Fuse-Bond process and equipment for its application, whereby machine components and similar metal parts now may be prepared for metallizing electrically. An advantage of the process is stated to be that it affords an adequate bond on the hardest surfaces, heretofore impossible or impractical to prepare by blasting or rough threading. It is also said to simplify the preparation of narrow edges, flat areas, and cylindric parts having keyways and other interruptions in their surfaces.

Operating on any 110- or 220-volt, single-phase power line, this equipment fuses a rough deposit of electrode metal into the surface to be metallized. Electrodes are applied to the work with a special holder that takes up to six electrodes at a time, depending on the size and nature of the part to be prepared. Small parts may be prepared with this equipment as easily as large shafts, since there is no excessive heating of the base metal or disturbing of its physical characteristics, it is stated. The Fuse-Bond unit is contained in a cabinet measuring 24 in. high. The weight complete is 170 lbs. All cables and attachments fit into a bin in the top of the cabinet. Mounted on casters, it can be wheeled to the job.

Preventing Welding Spatter Adhesion

No-Spat, a liquid said to prevent adhesion of welding matter, has recently been introduced. According to the manufacturer, No-Spat should be brushed over the seam and area where weld spatter may fall. After welding, the spatter may be wiped away, making chipping or grinding unnecessary. It is claimed that No-Spat fuses with the molten metal and maintains maximum weld strength by floating off impurities and preventing porosity, stabilizing the arc, minimizing rod spatter, and saving rod metal. Midland Paint & Varnish Company, Cleveland, O.

Financial Survey

Looking Up With Aviation in 1942 is the title of a booklet containing the fourth annual survey of finances and revenues of aircraft manufacturers and air transportation companies in the United States. A review is presented of the figures showing the volume of business handled by the aircraft industries, with details on the sources of working capital that enabled the companies to finance their expansion. Particular reference is made to government financing plans. In tubular form, figures are broken down into their various classifications, these figures being based on combined financial statements of manufacturers of light aircraft and the air lines. National Credit Office, Inc.

Superhard Rivets

A recent development is a superhard rivet said to be strong enough to replace bolts on aircraft or other structures. The new rivet has considerably lightened the weight of the wing of the P-51 Mustang fighter. Nearly 1,000 of the new rivets, which can be installed five times faster than bolts, are used in the Mustang's wing, replacing a large number of regular rivets and 798 heavier bolts.

The secret of the new rivet, which has been named the "Hi-shear" rivet, is in the method of installation. With a shear strength of 75,000 lbs. per sq.in., compared with a normal rivet's shear strength of 25,000 lbs., the Hi-shear rivet is too hard to be driven in the usual manner. Instead, it is riveted into place by a special tool that presses a small aluminum-alloy collar into the notched end of the stud, leaving a modified conical head. Excess length of the collar is sheared off automatically by the tool during the operation by pressure against the sharp edge on the tip end of the stud.

The new rivets are used in parts subject to shear loads where it previously was necessary to employ bolts. The rivets are made in two styles of heads, in several diameters, and in lengths to suit all conditions. They are being made available to other war manufacturers. North American Aviation, Inc., Inglewood, Calif.

Crankshaft Precision

Two-throw crankshafts for 14-cylinder radial engines require a high degree of precision machine work. More than 100 dimensions are held to a tolerance of one-thousandth of an inch or less. The bearing surfaces are finished to a tolerance of four-millionths of an inch. Over 600 machine operations are required for the production of each shaft.

The "floating" type of counterweight is employed to damp vibration. These crankshafts are used in engines that power the North American Mitchell bomber and the Grumman Avenger and Curtiss Helldiver. The Ohio Crankshaft Company, Cleveland, O.

Brush Applications

Brush engineering, involving many new techniques worked out by The Osborn Manufacturing Company of Cleveland, O., is speeding aircraft production and making highly stressed parts of plane engines more durable.

Osborn and the aircraft-engine industry have developed new applications for power brushing wheels and end brushes that rotate on headstocks, flexible shafts, drill presses and other appliances, brushing wheels made up in disc sections, cup brushes and end brushes of many different kinds of wire, fiber or cord.

One of the annoying bottlenecks in airplane-engine production was the truing of two tiny intersecting slots at the ends of bronze camshaft bushings. The edges had to be radiused and the surfaces blended. The slots were being hand-scraped, but even the most careful workman did not always leave them perfectly true and the job was so tedious he could complete only three in an hour.

A brushing formula was developed for this job, which now can be completed in a few seconds, with uniformly true surfaces as a result.

Some of the other jobs for which brushing formulas were developed are the removal of burrs from threads in propeller thrust-bearing nuts, brushing of crankshafts, camshafts and connecting rods, pistons, the ends of tubing, the edges of routed sheet metal, brushing of surfaces of material used in self-sealing gasoline tanks, removing of materials from around rivet holes for perfect bonding, removing burrs and flash from extruded parts, removing weld scale from motor mount supports, and removal of scale, grease, or other foreign matter from edges of sheet metal prior to welding.

Plexiglas Pin-Load Strength Data

The physics laboratories of Rohm & Haas Company have recently completed a series of tests on the pin-load bearing strength of Plexiglas. The results, which are summarized in a technical bulletin, are of value in calculating the number, size and position of bolts and rivets put through Plexiglas panels.

It is noted that in all of the many test conditions tried Plexiglas was capable of supporting, at 25°C., the maximum fiber stress of 1,000 lbs. per sq.in. recommended for all continued service applications.

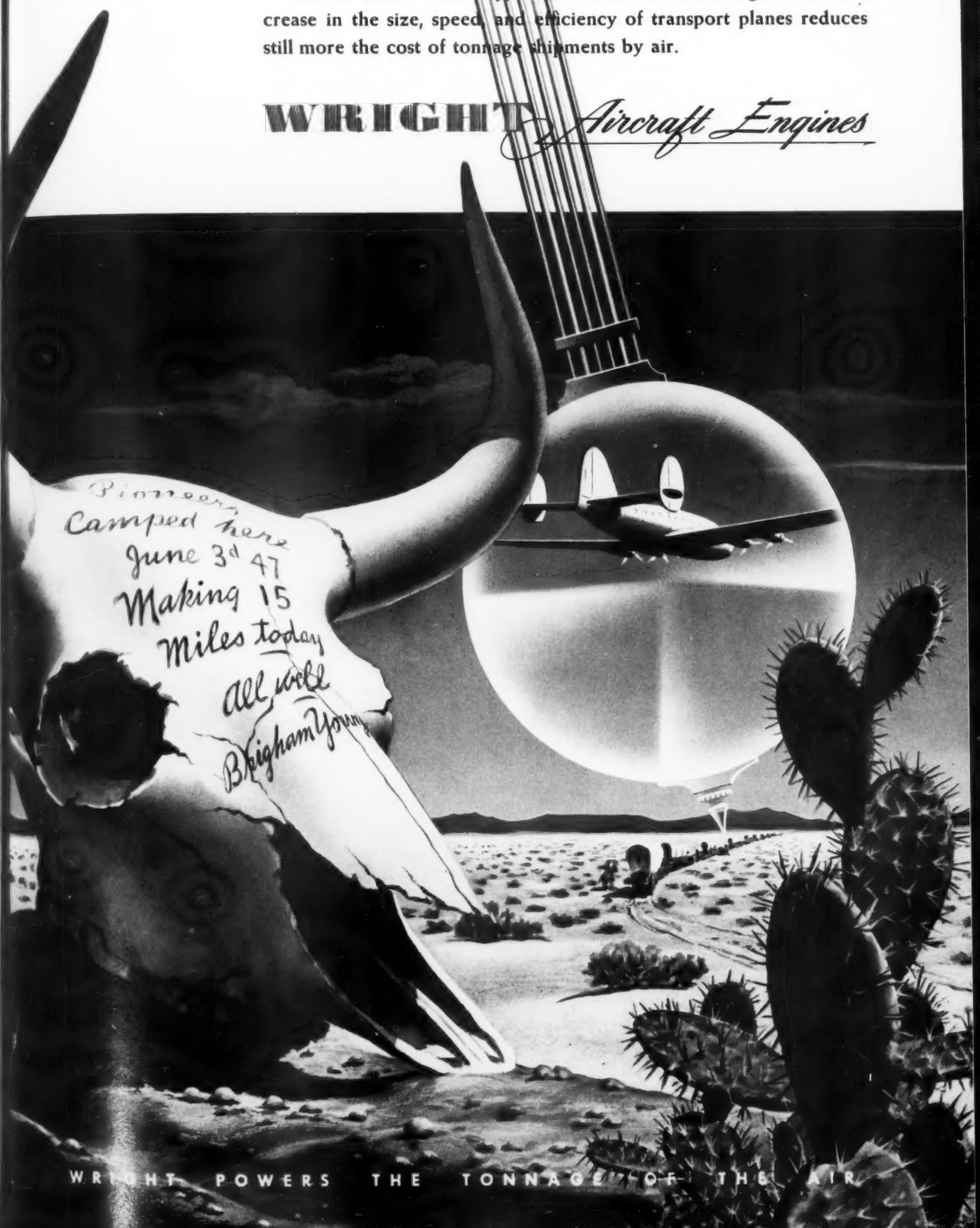
Although the manufacturers continue

What cost per ton mile?

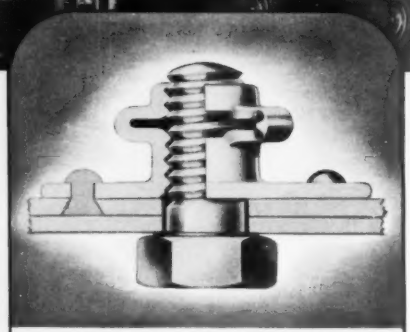
"Making 15 miles today—all well," wrote Brigham Young on an ox skull as the Mormon wagon train toiled its arduous way across America. That was costly transportation — costly in lives, labor, and time.

Fifteen miles — one day, is now *three minutes* of flight. Each increase in the size, speed, and efficiency of transport planes reduces still more the cost of tonnage shipments by air.

WRIGHT *Aircraft Engines*



WRIGHT POWERS THE TONNAGE OF THE AIR



A Self-Locking Thread

The Boots Self-Locking Nut is one-piece, all-metal—withstands severest vibration. The top (locking) section is displaced in a downward direction so that its locking threads are out of lead with the load carrying threads of the lower section.

Upon the insertion of a bolt, the top section of the nut is extended to engage with the threads of the bolt. A constant force is thus established which locks the nut firmly into position without damaging bolt or nut. Axial thread play is eliminated.

50,000 LBS. . . PROTECTED BY A THREAD

It's mighty important that the threads on the nuts which hold together vital parts of the Commando troopship should be dependable . . . that they be proof against even the most severe airplane vibration.

Boots All-Metal Self-Locking Nuts are used on these largest of all twin-engined cargo planes. They are unaffected by vibration—literally "outlast the plane."

Boots Nuts weigh less than other self-locking nuts . . . thus they make it possible for the Commando to carry more cargo. And they have greater reusability in maintenance.

Boots Nuts meet the exacting specifications of all Government agencies, are used on all types of planes.

The new Boots "Rol-Top" Nut, all-metal, has special advantage for engine application.

BOOTS

Self-Locking Nuts For Application In All Industries

BOOTS AIRCRAFT NUT CORPORATION ★ GENERAL OFFICES, NEW CANAAN, CONNECTICUT

to favor simple channel mountings for Plexiglas, they are confident that the material can safely be bolted or riveted where pressurizing the cabin or other considerations made positive attachment advisable.

Aluminum Alloy Castings

A new booklet describes the characteristics of Scott-Cast "40-E" aluminum-alloy castings, tracing the development of this alloy of magnesium, zinc, and aluminum, and showing the Army, Navy, and A.S.T.M. specifications that it is intended to meet. Its properties are discussed under the headings of yield strength, production facility, welding, furnace brazing, pressure casting, corrosion resistance, and climatic conditions. The booklet includes a reprint of the original research report of the American Society for Testing Materials on this alloy, as well as tables and charts recording its properties. Scott Aviation Corporation, Lancaster, N.Y.

High-Voltage Meter

Designed and manufactured by the Shallcross Manufacturing Company, Collingdale, Pa., the No. 760 Shallcross kilovoltmeter is said to conform with all the requirements of an efficient instrument for measuring high voltages. It meets specifications listed as: (1) low current consumption; (2) a completely self-contained unit; (3) three ranges—5, 10, and 20 kilovolts—in a single instrument; (4) ±2 per cent accuracy at full scale; (5) sensitivity of the movement to be 1,000 ohms per volt; (6) a rugged and portable instrument.

Reactance Slide Rule

A handy reactance slide rule that makes possible the rapid solution of reactance and resonant frequency problems is described in a leaflet issued by Shure Brothers, Chicago, Ill. On one side of this rule resonant frequency problems are solved with one setting of the slide and the use of a formula. On the other side of the rule reactance, dissipation factor, and coil "Q" problems are solved with one setting of the slide and the use of one of four formulas.

Man-Power Schedule

The completion of approved manning and replacement tables by the Square D Company's Kollsman Instrument Division plant in New York City is announced. The approved schedules represent an arrangement with the Selective Service System providing for the orderly withdrawal of drafted men to permit the training or hiring of replacement without reducing war production.

It is reported that this system affords a means of knowing not only how many employees will be withdrawn by the Selective Service System from each department of a plant but approximately when each man will be withdrawn, so that replacements can be planned and any interruption of production avoided. It also enables the company to inform draft-liable men definitely whether or not they will be deferred, and, if so, for how long.

The manning tables list separately each kind of job in the plant, together with the number of workers employed on that job and their classification as to age, sex, family situation, and Selective Service Board status. The withdrawal tables list the men who are eligible for induction, with a monthly schedule covering their release during the ensuing six months, according to the time required to secure and train their replacements and, hence, the amount of deferment required. Those for whom more than six months' deferment is requested are listed separately.

After the tables are approved, the employer merely files the appropriate form for each man with the various local draft boards concerned, and the withdrawal of the men automatically follows the schedule. The tables are recast and sent in for approval every six months.

Electric Sanding Machine

Sterling Tool Products Company, Chicago, Ill., announces its new No. 1000 electric sander, designed to meet requirements for heavy duty service. Its features include a streamlined, balanced and counterbalanced vibrationless unit, compact in size, with a handle designed comfortably to fit the hand of either men or women operators and a snap action switch located on the handle. It is powered by a $^1/_5$-hp. universal motor cooled by turbine-type fan and dust-protected by a replaceable filter screen. Its gears and counterpoise mechanism are sealed in a dustproof cartridge-type gear case. Moving parts are supported by oversized ball and needle type bearings and one sintered bronze bearing.

A quickly detachable sanding pad, operated by a simple latch-type lock, takes a $^1/_3$ sheet of standard abrasives and is made flexible to permit sanding on curved or flat surfaces. Tumbler action clamps operated by key or screwdriver lock the abrasive sheets on the sanding pad.

A new orbital motion sanding action is said to produce maximum cutting and leave a smooth sanded surface on wood, composition, or metal.

Combination Bracket and Fastener

To speed up angular attachments and reduce weight in aircraft and other war equipment, a complete line of new angle brackets with self-contained fasteners is now in production for nonstructural attachments. The feature of the bracket is an integrally formed Speed Nut in one or both sides, according to application need. The brackets are made for 8Z and 10Z Air Corps sheet metal screws and standard rivets. Tinnerman Products Inc., Cleveland, O.

Constant-Speed, Counterrotating Propeller Tested

A 12-ft., six-bladed, constant-speed, counterrotating propeller, which is actually two three-bladed propellers mounted coaxially, was recently flown from Rentschler Field in what was said to be the first American flight for such a propeller.

In 1934 an Italian racing seaplane with counterrotating propellers set a speed record of 440 m.p.h. It had two fixed-pitch propellers mounted on independent concentric shafts and driven by separate engines. In 1938 a Hamilton Standard fixed-pitch counterrotating propeller operating from one engine was installed on a U.S. Army plane for tests.

It is stated that the use of the counterrotating propeller solves three basic problems, giving the necessary increased blade area without increased breadth or length and neutralizing the torque reaction developed by a single propeller. A certain amount of rotational energy in the slipstream of the front propeller is also recovered by the second propeller and converted into useful work, thereby also straightening out the slipstream. Hamilton Standard Propellers Division, United Aircraft Corporation.

Parachute Harness Yarns

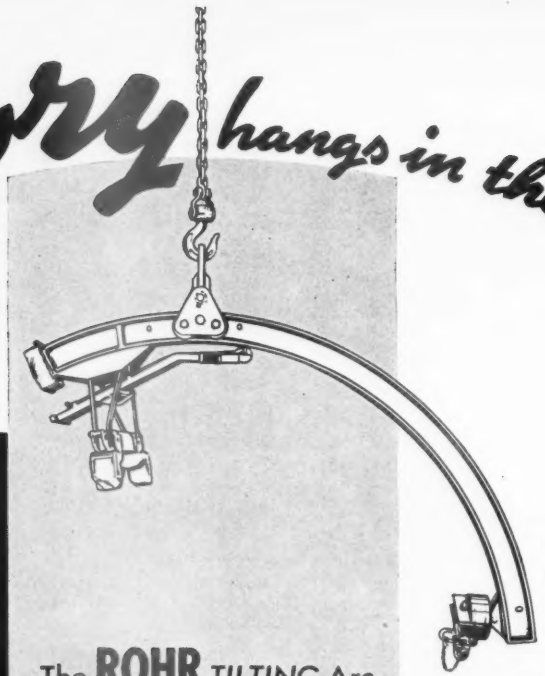
A new cotton yarn has been developed by United States Rubber Company. This yarn, called Ustex, is reported to have been approved by Wright Field for parachute harnesses.

Ustex does not require the long staple cotton that is now a critical military raw material but uses a type that is readily available, producing yarn said to be the equivalent of linen in strength. It is stated that orders have been received for more than 1,500,000 lbs. and the first large unit, authorized by W.P.B., will be completed this month at the textile mills of the rubber company at Winnsboro, S.C.

The new process is called a combination of chemical and mechanical treatment. With it strong cotton yarns can be produced from regular grades of cotton without special carding, combing, or twisting operations. In addition to having increased strength, cotton yarns produced by the Ustex method are claimed to have good resistance to weathering and mildew.

Although the company's total production of Ustex yarns at present is under allocation for parachute harnesses the company, working with research and development branches of the government, has produced experimental lots of special Ustex yarns for other military applications.

Victory hangs in the balance.



ROHR

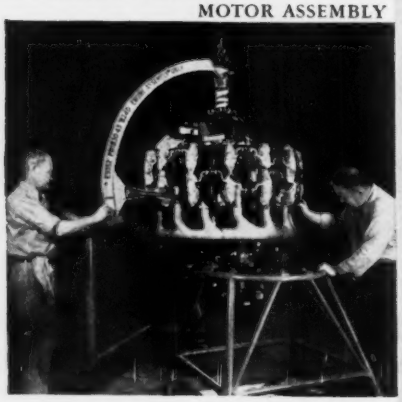
PARTS ☆ ASSEMBLIES

The **ROHR** *TILTING* Arc is typical of American ingenuity which is swinging the production balance further in favor of the Allies. It is just one of the many specially conceived devices and methods by which Rohr Production Fighters speed their thousands of tasks to ready Rohr equipped planes for the war front.

The Rohr Tilting Arc enables *fewer* men to turn out *more* work in *less* time and with *less* fatigue. It suspends heavy aviation motors in so delicate a balance that the pressure of a workman's hand moves them to any position within a 90° arc. Its application to fields of final assembly and advanced base repair increases its win-the-war service immeasurably.

HELPING TO WRITE
THE STORY OF TOMORROW

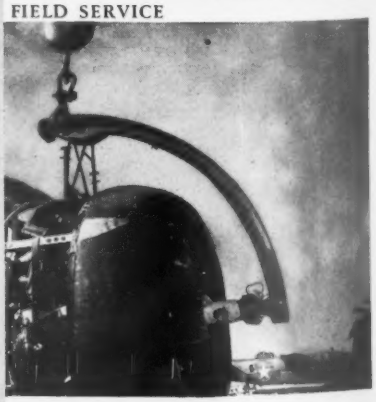
CLEANING A MOTOR



MOTOR ASSEMBLY

MATING A WING

FIELD SERVICE



ROHR AIRCRAFT CORPORATION — *CHULA VISTA, CALIFORNIA*

Institute News

Sections and Branches

Akron Section

The first regular meeting of the Akron Section took place on December 16, 1942. Dr. Karl Arnstein spoke on "Lighter than Aircraft's Contribution to Aviation." E. G. Shaw was another speaker, his topic being "Model Testing of Structures."

A meeting was also held on January 13, at which W. H. Hunter of The B. F. Goodrich Company spoke on "Notes on the Problem of Aircraft Deicing."

San Diego Section

An important meeting of the San Diego Section was held on January 22. A total of 352 members and guests including leaders in Southern California aeronautical industries, attended the banquet that was held at the El Cortez Hotel in San Diego.

E. G. Stout, Chairman of the Section acted as toastmaster and opened the meeting with greetings to members and guests. He read a telegram from Major Lester D. Gardner, Executive Vice-President, congratulating the San Diego Section on its rapid growth and extending wishes for the success of the meeting.

The guest speakers were T. M. Girdler, Chairman of the Board, Harry Woodhead, President, and I. M. Laddon, Executive Vice-President and General Manager, all of Consolidated Aircraft Corporation.

Mr. Girdler's address was on "The Future of Aviation," in which he took a reassuring point of view. He expressed the opinion that the aeronautical industry will not encounter a period of severe depression after the war as some pessimists have thought. He also emphasized the belief that consideration of the future of the aircraft industry should take a place secondary to the task immediately at hand, which is to meet the demands for war equipment and to concentrate all effort on the winning of the war.

Mr. Woodhead spoke in a somewhat humorous vein on "The Relation Between Production and the Engineer." He explained the necessity for the coordination of the engineering and production departments in order to produce the best results.

The final speaker of the evening was Mr. Laddon who commented on his trip to England as a member of an American Aircraft Commission, which surveyed the British aircraft industry. The British method of producing airplanes and the difficulties under which the British are operating was explained.

Carnegie Institute of Technology

The first meeting of the semester was a dinner meeting, which was held on January 21 at the Royal Yorke Hotel with an attendance of 27 students. The speaker was Dr. Harris, local examiner for Civilian Pilot Training, whose subject was "Physiological Reactions in High-Altitude Flight."

Casey Jones School of Aeronautics

At a recent meeting the Student Branch Chairman appointed the following officers to fill vacancies caused by the calling of the incumbents into the armed services. These appointments were as follows: Secretary, F. Zultewicz; Treasurer, B. Malchodi; Corresponding Secretary, G. Nicoletti. The former officers, who were seniors and members of the enlisted reserve, were: A. De Palma; W. Engert, Secretary; M. Golden, Corresponding Secretary; M. Ginsberg, Treasurer, and N. Oderman.

University of Cincinnati

Recent weekly meetings of the Branch were featured by talks by students on various subjects of interest to those engaged in the aeronautical sciences. Wayne Bryant spoke on plastics and their importance in modern aircraft construction. John Burkham talked on helicopters, covering their history, problems, and applications. Bruce Hartman discussed the use of hydraulics for airplane control systems.

This year the Student Branch will give a composite picture of the graduating class to each of its Aeronautical Engineering seniors.

Indiana Technical College

Regular meetings were held on October 12, October 26, November 16 and December 7, 1942. These were all well attended and were featured by the presentation of papers or the showing of pictures. The November meeting included the Fall term banquet, held at the Wayne Hotel.

The meeting on January 11 was devoted principally to a revision of the constitution of the Branch, and the revised constitution was approved. A picture, *The Story of the Airship*, furnished by the Goodyear Aircraft Corporation was shown. At the meeting on February 1, Lieutenant Baldwin of the Civil Air Patrol gave an explanation of the Lorenz blind landing system and Tom Millard read a paper on "Design of Injection Nozzles for Diesel Engines."

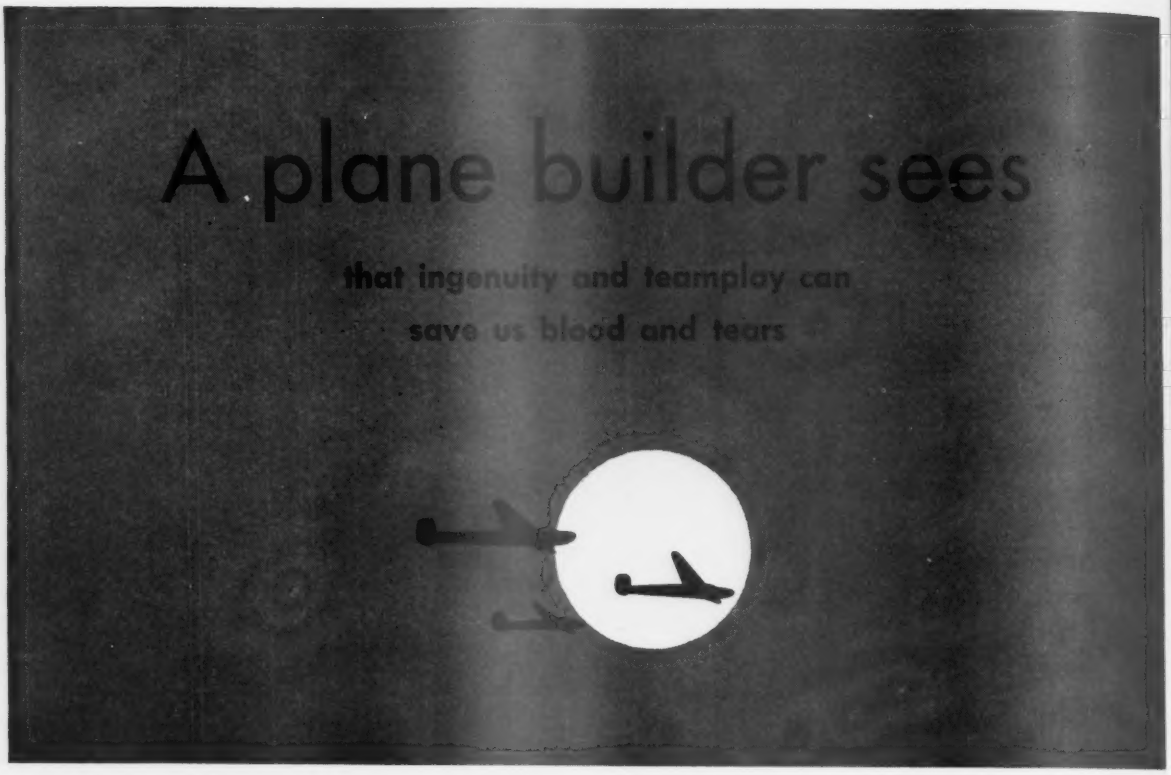
Iowa State College

A talk, illustrated with slides, was given by Warren Hays at the meeting on January 20. The talk was based largely on the speaker's experiences at the Ford glider factory.

New officers were elected as follows: Chairman, Robert Caswell; Vice-Chairman, Merle Evers; Junior Representative, Warren Hays; Secretary, Oliver Harwood; Treasurer, James McCoy.

New York University

A smoker was the feature of the meeting on January 21. Charles Froesch, Chief Engineer of Eastern Air Lines, Inc., talked on Air-cargo transportation. The general trend of air transportation was briefly outlined, as well as its applications and limitations. The characteristics of a cargo airplane and its



THERE IS A NEW electrolytic etching technique of duplicating templates for new-design warplanes. It saves 5 weeks in getting a new model from blueprints to fighting planes on the front. The "Northrop group" developed this technique, offers it to all U.S. plane builders.

There's a new "Heliarc" process by which magnesium and certain other alloy metals can at last be welded into aircraft parts. It uses *helium*, of which the U.S. has 98% of the world's supply. This Northrop development is being made available to other U.S. aircraft builders.

There's an improved way of cleaning and preparing sub-assemblies for spot welding. It helps to complete warplanes in less time, saves vital plant space. It also has been turned by Northrop into the "pool" every U.S. plane factory is free to use.

Into this same "all-for-one-one-for-all" pool other aircraft builders are turning new processes and discoveries.

Not only techniques, but production facilities are now shared by the industry. For instance, besides its own aircraft, Northrop has been making dive bombers designed by another company . . . engine nacelles for a bomber manufacturer . . . and tail-assemblies for a flying boat builder.

May we emphasize—there is nothing peculiar to Northrop in this kind of teamplay and ingenuity. *Today all of the aircraft builders in the United States are working as one. Because to do so will save American blood and tears.*

NORTHROP AIRCRAFT, Inc.

NORTHROP FIELD, HAWTHORNE, CALIFORNIA . . . MEMBER AIRCRAFT WAR PRODUCTION COUNCIL, INC.

probable design requirements were stressed. The speaker highlighted his talk with a prediction on the use of Diesel engines for propulsion as further increases take place in the power requirements of such aircraft.

At a meeting on February 4, the speaker was C. L. Morris, Engineering Test Pilot of Vought-Sikorsky Division of United Aircraft Corporation, who discussed helicopters. The principles of operation of the craft were explained, including the power connections, the maintenance of stability, and the characteristics of the craft with power shut-off. A film was shown depicting the operation of the craft.

The following films have been presented at recent meetings of the branch: November 20, 1942, *Study of Air Flow by Means of Smoke;* November 28, 1942, *The N.A.C.A. Free-Spinning Wind Tunnel;* January 6, 1943, *The Fundamental Nature of Air Flow and Air Flow Separation;* January 22, 1943, *A Study of Air Flow in an Engine Cylinder;* and January 28, 1943, *A Study of Combustion in a Spark Ignition Engine.*

Spartan School of Aeronautics

At the first meeting for the new quarter the following new officers were elected: Herman Eley, Chairman; Gene Train, Secretary; Alan Campbell, Treasurer; and Stanley Curtis, Program Chairman.

Following the election Joseph Ross spoke on "How New Methods Have Increased Aircraft Production." Chairman Eley discussed aircraft design.

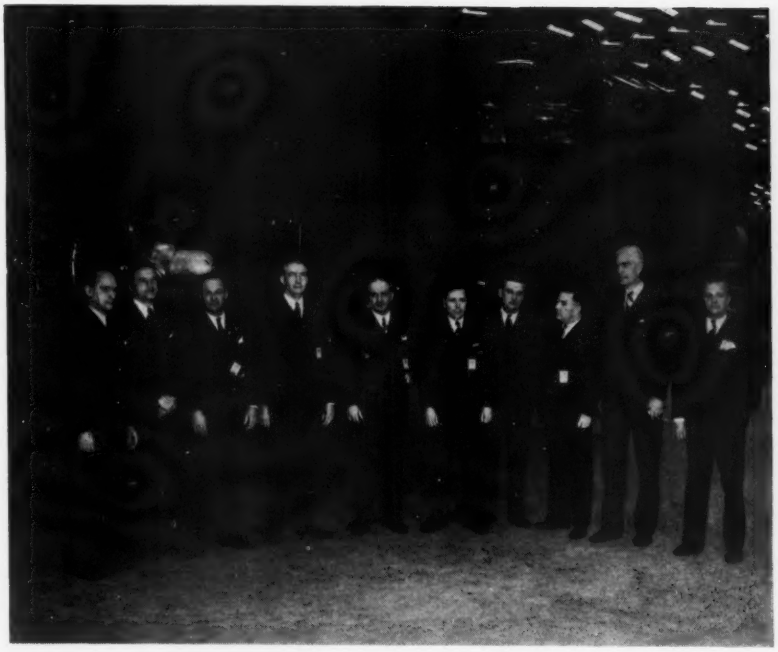
Stanford University

The January 20 meeting was featured by the reading of the Wright Brothers Lecture, followed by a discussion guided by Professor Reid, who elaborated on various points of the lecture.

Aircraft War Production Council, East Coast, Inc.

Glenn L. Martin, President of The Glenn L. Martin Company, was elected to succeed G. W. Vaughan, President of Curtiss-Wright Corporation, as President of the Aircraft War Production Council, East Coast, Inc., at a meeting of the Board of Directors and various committees of the organization. J. Carlton Ward, Jr., President of Fairchild Engine & Airplane Corporation, was elected Vice-President.

President Martin predicted that output of war weapons in 1943 will exceed by a comfortable margin the total of 1942 in every respect. Mr. Ward stated that one of the outstanding accomplishments of the initial period of the organization's existence had been an arrangement for the exchange of service men and other engineering personnel.



This photo, taken beside the nose of a Curtiss Commando (C-46) military transport plane, shows ten members of the Aircraft War Production Council, East Coast, Inc., who attended the organization's January 18 meeting in Buffalo, N.Y.

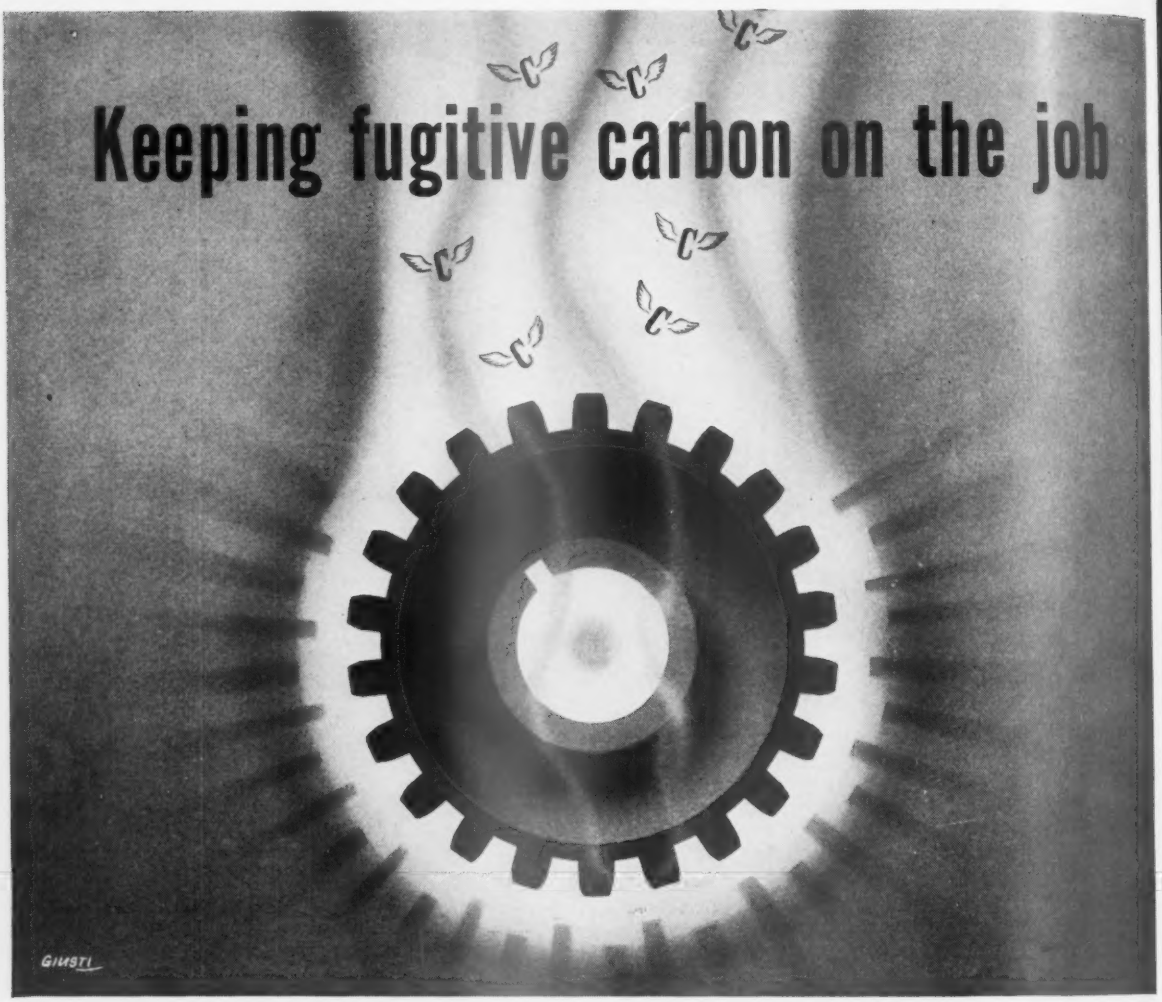
Shown, *left to right*, are: C. A. Van Dusen, President of Brewster Aeronautical Corporation; Ralph S. Damon, President and General Manager of Republic Aviation Corporation; G. W. Vaughan, President of Curtiss-Wright Corporation and the Council's first President; Glenn L. Martin, President of The Glenn L. Martin Company and new President of the Council; Victor Emanuel, President of The Aviation Corporation; L. C. Goad, General Manager of the Eastern Aircraft Division of General Motors Corporation; Burdette S. Wright, Vice-President of Curtiss-Wright Corporation in charge of its Airplane Division; Lawrence D. Bell, President of Bell Aircraft Corporation; J. Carlton Ward, Jr., President of Fairchild Engine & Airplane Corporation and the Council's new Vice-President; and I. S. Randall, General Manager.

The aircraft manufacturing companies that comprise the Eastern Council are: The Aviation Corporation, Bell Aircraft Corporation, Brewster Aeronautical Corporation, Curtiss-Wright Corporation, The Eastern Aircraft Division of General Motors Corporation, Fairchild Engine & Airplane Corporation, The Glenn L. Martin Company, and Republic Aviation Corporation.

Manufacturers Aircraft Association

Many members of the Institute were included among officers and directors of the Manufacturers Aircraft Association elected at the recent annual meeting. Samuel S. Bradley was elected Chairman of the Board, with Frank H. Russell as President and John A. Sanborn as General Manager. Elected as vice-presidents of the Association were Edgar N. Gott, of Consolidated Aircraft Corporation; R. E. Gross, of Lockheed Aircraft Corporation; Joseph T. Hartson, of The Glenn L. Martin Company; J. H. Kindelberger, of North American Aviation, Inc.; John M. Rogers, of Douglas Aircraft Company, Inc.; William E. Valk, of Curtiss-Wright Corporation; and Eugene E. Wilson, of United Aircraft Corporation. James P. Murray, of Boeing Aircraft Company, was made Secretary and Clayton J. Brukner, of Waco Aircraft Company, was re-elected Treasurer.

The Board of Directors for 1943 will include the following, in addition to Messrs. Bradley, Russell, Valk, Murray, and Brukner: Alexander T. Burton, of North American Aviation Inc.; Charles H. Chatfield, of United Aircraft Corporation; Frank N. Fleming, of Douglas Aircraft Company, Inc.; G. Sumner Ireland, of Lockheed Aircraft Corporation; George D. Jones, of The Glenn L. Martin Company; Raymond S. Pruitt, of Consolidated Aircraft Corporation; and Ray P. Whitman, of Bell Aircraft Company.



TO WIN A WAR, we *must* have hardened steel gears, pinions, and other essential parts that can take a terrific beating—and keep on going.

All steel is basically a mixture of *iron and carbon*. To bring out its stamina and strength, steel must be heat-treated at high temperature.

But the carbon in steel is a *fugitive* thing. When exposed to highly heated air, carbon literally "boils off" the metal. The steel surface gets softer through loss of carbon.

The problem in heat-treatment is to keep fugitive carbon on the job—in the steel surface where maximum wear and strain occur.

Fortunately, Westinghouse Engineers tackled this problem years ago. They developed an "artificial atmosphere" in heat-treating furnaces that would not rob steel of its fugitive carbon—that left hardened steel parts *clean and free of scale.*

It is known as the Westinghouse "*Endogas*" Balanced Atmosphere. It is made from inexpensive natural or manufactured city gas—in a self-contained mixing chamber which is simple and easy to operate. It is exclusively a Westinghouse development.

And the balanced atmosphere in the "*Endogas*" Furnace may be varied, at will, for heat-treating practically *any kind of steel*—by merely changing the proportion of fuel gas and air in the mixing chamber. A typical result of Westinghouse "know how" in solving a problem that has perplexed metal workers since primitive man hammered out his first battle-ax!

Today, Westinghouse "*Endogas*" Furnaces are heat-treating vast quantities of gears, cams, dies, and other steel parts. They are setting the pace as

America's astonishing war-production shifts into high.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Penna.

Westinghouse

PLANTS IN 25 CITIES...OFFICES EVERYWHERE

News of I.Ae.S. Members

Dr. George W. Lewis, H.F.I.Ae.S., for many years director of Aeronautical Research of the National Advisory Committee for Aeronautics, was elected Chairman of the Collier Trophy Award Committee.

A. F. Arcier, A.F.I.Ae.S., Chief Engineer of Waco Aircraft Company, has been elected to the newly created office of Vice-President in Charge of Engineering and Director of the company.

Richard H. Depew, Jr., A.F.I.Ae.S., recently assumed his new duties as Production Coordinator at the Fairchild Aircraft Division of Fairchild Engine & Airplane Corporation. He was formerly General Manager and Executive Vice-President of Taylorcraft Corporation. Mr. Depew's new connection will be a renewal of a former association, since 13 of his 20 years in the industry have found him identified in one way or another with Fairchild interests.

George H. Dowty, A.F.I.Ae.S., Managing Director and founder of Dowty Equipment Ltd. of England, has been made a member of the Council of the Royal Aeronautical Society of London.

Bruce G. Leighton, A.F.I.Ae.S., is now a Special Assistant to the Production Vice-Chairman of the War Production Board.

Howard R. Moles, A.F.I.Ae.S., was transferred from the St. Louis Airplane Division and made Chief Engineer at the Louisville Plant of Curtiss-Wright Corporation.

George F. Taylor, A.F.I.Ae.S., received his commission as Captain in the U.S. Army Air Forces and was assigned to duty at the Air Forces Technical School at Grand Rapids, Mich.

John R. Weske, A.F.I.Ae.S., on leave of absence as Associate Professor of Aerodynamics, Case School of Applied Science, has joined the General Electric Company as Consultant in the General Engineering Laboratories, Electro-Mechanical Section.

C. J. Brukner, M.I.Ae.S., was re-elected President of Waco Aircraft Company.

Georges F. Doriot, M.I.Ae.S., on leave of absence as Professor of Manufacturing, Harvard Graduate School of Business Administration, received his commission as Colonel in the United States Army and is on active duty as Chief of Research and Development Branch, Military Planning Division, Office of the Quartermaster General.

Joseph V. Foa, M.I.Ae.S., has been appointed head of the Design Section, Research Division at the Buffalo Plant of Curtiss-Wright Corporation.

William M. Hawkes, M.I.Ae.S., received his commission as Lieutenant in the U.S. Navy and is on duty as Engineering Officer, Experimental Squadron.

William P. Kennedy, M.I.Ae.S., has been made Assistant Manager, Military Contracts, in the Buffalo Plant of Curtiss-Wright Corporation.

Lewis C. McCarty, Jr., M.I.Ae.S., is Vice-President of The Intercontinent Corporation.

Robert M. McFarlane, M.I.Ae.S., was recently made Stress Group Leader in The Glenn L. Martin Company.

Alfred L. Wolf, M.I.Ae.S., was commissioned a Captain in the Air Transport Command, U.S. Army Air Forces.

George K. Anderson has joined Hoosier Aircraft Company, Inc.

Morris C. Anderson is Assistant to Works Manager, W. & L. E. Gurley Company, makers of engineering instruments.

Robert W. Bratt has been commissioned a Second Lieutenant in the U.S. Army Air Forces.

Orville V. Chamberlain is on a military furlough and has become an Aviation Cadet, Engineering, U.S. Army Air Forces.

Felix Chardon, formerly with Brewster Aeronautical Corporation, has joined Waco Aircraft Company.

James M. Crook, was recently appointed Stress Engineer in the Fairchild Aircraft Division of Fairchild Engine & Airplane Corporation.

Lofton De S. Crow, formerly Flight Instructor at Parks Air College, has become a Test Pilot with the St. Louis Airplane Division of Curtiss-Wright Corporation.

Maurice D. Curr is a Liaison Engineer with Ryan Aeronautical Corporation.

Harry S. Egerton has been appointed Assistant Administrative Engineer at Kellett Autogiro Corporation.

Byron Freeman, Weight Engineer with Curtiss-Wright Corporation, has been transferred to the Louisville Plant.

George L. Fruauff, Jr., joined the Eastern Aircraft Division of General Motors Corporation as Final Inspector in Final Assembly at the Linden Division.

Heighton D. James, formerly Stress Engineer at Timm Aircraft Corporation, has joined the Army Air Forces as Engineer at Wright Field.

Eugene J. Korda has joined North American Aviation as Head of Production Illustrations & Designer.

Herbert C. Langmore has rejoined Lockheed Aircraft Corporation as Engineer, after a period as Wing Design Engineer at the Willow Run Plant of the Ford Motor Company.

Harvey A. Leich has been promoted to Captain and Engineering Officer, U.S. Marine Corps, and assigned to duty at a Marine Air Station in California.

Harold E. Lemont, Jr., formerly Stress Analyst at Grumman Aircraft Engineering Corporation, has joined the United Aircraft Corporation in a similar capacity.

Thomas Olsson received his commission as Lieutenant, Bombardment Squadron, U.S. Army Air Forces.

Russell Howard joined the Sikorsky Division of United Aircraft Corporation as Aeronautical Engineer.

Richard N. Rioux has been made Chief Engineer of the Manufacturing Division of Robertson Aircraft Corporation.

Franz J. Schnaubelt, formerly in the Production Engineering Department of Consolidated Aircraft Corporation, has been transferred to Engineering Representative, Engineering Group, Sub-Contract Production Department.

Milton R. Schoenfeldt has been promoted to Assistant Project Engineer at North American Aviation, Inc.

Leon Z. Seltzer now holds the rank of Associate Professor of Aeronautical Engineering at Virginia Polytechnic Institute.

William B. Shepard, formerly a draftsman with Waco Aircraft Company, has joined Luscombe Engineering Company in a similar capacity.

Alston B. Voorhees, during 1943, will be at Briggs Manufacturing Company as Boeing Aircraft Liaison Engineer Representative.

Henry F. Waring, Jr., recently joined the U.S. Army Air Forces as an Aviation Cadet at Jefferson Barracks.

Frank B. Wozniak joined Vultee Aircraft Corporation as an Engineer, having formerly been with Stout Skycraft Corporation.

Eli A. Zeitlin has been transferred from the Bureau of Aeronautics of the Navy Department and is now Associate Aeronautical Engineer with the Civil Aeronautics Authority.

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Ap No. 11

Members Elected

The following applicants for membership or applicants for change of previous grade have been admitted to membership in the grades indicated since the publication of the list in the last issue of the REVIEW.

Transferred to Associate Fellow Grade

Korsak, Kazimierz, Ae.E.; Aero. Engineer, "Prenco" Progress & Engineering Corp.

Elected to MEMBER Grade

Berman, Leon Jerry, B.Ae.E.; Design Engineer, Vultee Aircraft, Inc.

Bokeko, Bernard, B.S. in M.E.; Stress Analyst, E. G. Budd Mfg. Co.

Conn, Richard John Hugh, Naval Aviator (Engineering Duty only), Naval Aircraft Factory, Navy Yard, Pa.

Esval, Orland Ettreim, B.S. in E.E.; Director, Aircraft Instrument Research, Sperry Gyroscope Co., Inc.

Grimm, Bruce F., Jr., B.S.; Project Stress Engineer, Fisher Aircraft Unit, General Motors Corp.

Hamson, Joseph Henry, Asst. Group Engineer, Consolidated Aircraft Corp.

Jones, William Wesley, B.S. in E.; Lt. Col., U.S. Army Air Forces; Research Assoc. in Military Meteorology, Institute of Meteorology, University of Chicago.

Kluge, Robert William, B.S. in M.E.; Aircraft Structures Engineer, Bell Aircraft Corp.

Litrownik, Irving, Sr. Stress Engineer, Vega Aircraft Corp.

Mackenzie, Neil John Gregor, B.Sc. in Ae.E.; Chief Project Engineer, Sutton Horsley Co. Ltd., Canada.

Miller, Roy Gilman, B.S.; Engineering Representative, Curtiss-Wright Corp.

Mulvey, Hugh Joseph, B.S. in Ae.E.; Stress Analyst, Kellett Autogiro Corp.

Newkirk, Burt L., Ph.D.; Professor, Aero. Dept., Rensselaer Polytechnic Institute.

Pattison, William James, Ae.E.; Ensign, A-V(N), U.S.N.R.

Reissner, Eric, Ph.D.; Asst. Professor of Mathematics, Massachusetts Institute of Technology.

Sievert, Will C.; Sales & Underwriting, U.S. Aviation Underwriters, Inc.

Smith, Sebie B., Chief of Aircraft Instrument Dept., Embry Riddle School of Aviation.

Stone, Melvin, B.Ae.E.; Structures Engineer, Douglas Aircraft Co., Inc.

Viscardi, John Edison, M.E.; Director of Development & Research, Aero Parts Mfg. Co.

Westbrook, R. C., B.S.; Stress Analyst, Vultee Aircraft, Inc.

Transferred to MEMBER Grade

Burke, Woodward, B.S. in M.E.; Lt., U.S.N.R.; Chief Test Pilot, Brewster Aeronautical Corp.

Crockett, Harold Brown, M.S. in Ae.; Aerodynamics Research Engineer, Lockheed Aircraft Corp.

Steinbacher, Franz R., M.S.; Asst. Professor, University of Michigan.

Elected to Industrial Member Grade

Dowd, Raymond Ernest, Chief Engineer, The Russell Mfg. Co.

Vineyard, Richard R., Project Engineer, Virginia Lincoln Corp.

Elected to Technical Member Grade

Beers, George Edward, B.Ae.E.; Design Structural Engineer, United Aircraft Corp.

Bergquist, G. H., B.S. in C.E.; Stress Analyst, Goodyear Aircraft Corp.

Black, Sydney D., M.S.; Engineer, U.S. Army Air Forces.

Buscaglia, Anthony R., B.Ae.E.; Aero. Engineer, Andover Kent Aviation Corp.

Carter, Richard H., B.S.; Research Engineer, United Aircraft Corp.

Casaretto, Verne G., Shop Liaison Engineer, Vega Aircraft Corp.

Chao, Ping Shen, Engineering Draftsman, Stress Analyst, Republic Aviation Corp.

Chesley, George Basil, B.S.; Stress Analyst, United Aircraft Corp.

Cooper, Frank D., B.S.; Stress Analyst, Goodyear Aircraft Corp.

Cox, Herbert Orville, B.S.; Electrical Engineer, California Institute of Technology.

Dailey, Charles Lee, M.S. in Ae.; Aerodynamicist, El Segundo Div., Douglas Aircraft Co., Inc.

Froelich, Arthur Otto, C.E.; Stress Analysis Engineer, Kellett Autogiro Corp.

Gershon, Milton, M.E.; Engineer, Brewster Aeronautical Corp.

Hollrock, Richard H., Sc.B.; Stress Analyst, United Aircraft Corp.

Howe, William Robert, B.S. in M.E.; Jr. Test Flight Engineer, Airplane Div., Curtiss-Wright Corp.

Jeppesen, Norman L., B.S.; Stress Analyst, Goodyear Aircraft Corp.

Jones, Ray Satterfield, M.S.; Aerodynamicist, North American Aviation, Inc.

Kurkjian, Haig, Aircraft Electrical Engineer, Kellett Autogiro Corp.

Leap, Howard Edward, Jr., A.E.; Research Associate, George Washington University.

Roelke, Charles Theodore, B.E. in M.E.; Installation Engineer, United Aircraft Service Corp.

Scanlan, Robert H., S. M.; Engineering Mathematician, Fleetwings, Inc.

Stillman, Allan, B.Ae.E.; Group Leader, York Aircraft Co.

Thomas, James Arthur, Ae.E.; 2nd Lt., U.S. Army Air Forces.

Tripp, Ralph Harry, Ph.D.; Engineer, Stress Dept., Grumman Aircraft Engineering Corp.

Wheelock, Robert H., Flight Research Engineer, Bell Aircraft Corp.

Whitelaw, Robert L., B.A.Sc.; Resident Inspector, British Air Commission at American Central Mfg. Corp.

Zimmerman, William J., Stress Analyst, Pratt Read & Co.

Transferred from Student to Technical Member Grade

Anderson, John Welrose, B.S. in Ae.E.; Flight Test Engineer, United Aircraft Corp.

Anderson, Raymond Albert, B.S. in G.E.; Jr. Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Bartling, Loren Edward, B.S. in M.E.; Ensign A-V(P), U.S.N.R.

Bauer, Chester Robert, B.Ae.E.; Aerodynamicist, Douglas Aircraft Co., Inc.

Belbruno, Anthony Lucius, Liaison Engineer, United Aircraft Corp.

Bennett, Donald Edwin, B.S. in Ae.E.; Engineer, McDonnell Aircraft Corp.

Bird, John Dexter, B.Ae.; Jr. Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Broun, Thomas Archibald, B.Ae.E.; Ensign, U.S. Navy.

Buckley, Edward Paul, B.Ae.E.; Instructor, Rensselaer Polytechnic Institute.

Carlson, Everett, B.Ae.E.

Casey, Robert Emmett, III, B.Ae.E.; Clerk, F. W. Myers & Co., Inc.

Crown, John Conrad, B.Ae.E.; Jr. Aero. Engineer, Ames Aero Lab., N.A.C.A.

Dennee, Harley Edward, B.S.; Section Supervisor, Ford Willow Run Bomber Plant.

Dodge, Charles Hamill, B.Ae.E.; Apprentice Engineer, United Aircraft Corp.

Donaldson, Coleman du Pont, B.Ae.E.; Jr. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Draschil, Thomas Eugene, Engineering Asst., Lockheed Aircraft Corp.

Gero, Doane R., M.S. in Ae.E.; Jr. Stress Analyst, The Glenn L. Martin Co.

Gosnell, Hugh Hanlan, B.S. in Ae.E.; Jr. Research Engineer, National Research Council, Canada.

Gotterer, Malcolm Harold, Inspector, Bendix Aviation Corp.

Hack, Donald Otto, B.S. in Ae.E.; Student Designer, Pratt & Whitney Aircraft Div., United Aircraft Corp.

Hintermister, Robert Alfred, B.M.E.; Engineer, Pratt & Whitney Aircraft Div., United Aircraft Corp.

Kinney, Robert Elliot, B.S. in M.E.; Aerodynamicist, Fleetwings, Inc.

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Blue Island, Illinois (Subsidiary of Wickwire Spencer Steel Company)

Kneisel, John Francis, B.S. in G.E.; Ensign, U.S. Navy.

Lesko, James Steven, Wind Tunnel Test Engineer, United Aircraft Corp.

Love, Charles Carleton, Jr., B.S. in Ae.E.; Engineer, Boeing Aircraft Co., Inc.

Maleske, Alexander Robert, Jr., B.S. in Ae.E.; Maintenance Supervisor, Air Service Command, U.S. Army Air Forces.

Mathews, Charles Wesley, B.Ae.E.; Jr. Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

McFarland, Donald Lee, B.S. in Ae.E.; Design Engineer, United Aircraft Corp.

McKinney, Marion I'Dell, Jr., B.S. in G.E.; Jr. Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

McNairy, Addison Woollen, B.S. in M.E.; Jr. Engineer, Grumman Aircraft Engineering Corp.

Menei, James Joseph, Ae.E.; Jr. Engineer, Naval Aircraft Factory, Philadelphia, Pa.

Oates, Clifford, Jr., B.A.E.; Apprentice Engineer, United Aircraft Corp.

Oliver, Edward Dionysius, Jr., Private, U.S. Army Air Forces.

Paniszczyn, Thomas Francis, B.Ae.E.; Instructor, Rensselaer Polytechnic Institute.

Parker, Garth, B.S. in Ae.E.; Jr. Research Engineer, National Research Council, Canada.

Peraino, Salvatore James, Detail Designer, Fairchild Aircraft Div., Fairchild Engine and Airplane Corp.

Peters, Robert John, B.S. in A.E.; Stress Analyst, Airplane Div., Curtiss-Wright Corp.

Petrovits, Stephen, B.S.; Apprentice Engineer, Pan American Airways System.

Pinsly, William, B.S. in Ae.E.; Aerodynamicist, Airplane Div., Curtiss-Wright Corp.

Rice, Norman, Operations Engineer, American Export Airlines, Inc.

Riebe, John Michael, B.Ae.E.; Jr. Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Seacord, Charles Lynn, Jr., B.S. in G.E.; Jr. Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Sherman, Windsor Lewis, Ensign A-V(P), U.S.N.R.

Sonia, John, Detail Draftsman, United Aircraft Corp.

Stokke, Allen Randolph, B.A.E.; Jr. Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Sugden, John William, III, Aviation Cadet, U.S.N.R.

Wheatley, Gordon Hamilton, Pre-flight Inspector, Boeing Aircraft of Canada Ltd.

Wilder, John Granville, Jr., B.S. in G.E.; Weight Control Engineer, Airplane Div., Curtiss-Wright Corp.

Young, William Marshall Lee, B.S. in Ae.E.; Ensign A-V(P), U.S.N.R.

Ziff, Howard Lewis, B.Ae.E.; Aviation Cadet, U.S. Army Air Forces.

Zilka, Thomas J., B.S. in M.E.; Instructor, Aero. Engineering, Oregon State College.

Elected to Affiliate Grade

Correa, Joary, Casey Jones School of Aeronautics.

Lindersmith, Kenneth W., Supervisor Production Control, Timm Aircraft Corp.

Marcello, Jorge, Defense Supplies Corp.

Meisenhelder, Robert John, 2nd Lt., U.S. Army Air Forces.

Saavedra, Julio Martin Florez, B.S.; Airline Jr. Pilot (Co-pilot), Avianca Airways System, South America.

Vellinga, James T., Detail & Design Checker, Lockheed Aircraft Corp.

Necrology

Edmund Turney Allen

Edmund Turney Allen, Director of Flight and Aerodynamics at Boeing Aircraft Company, lost his life in an accident in a four-engined bomber at Seattle on February 18, 1943. For many years Mr. Allen had been one of the leading engineering test pilots in the United States and was outstanding in the field of aerodynamic flight testing of aircraft.

Born in Chicago, January 4, 1896, Edmund T. Allen attended the University of Illinois, the Massachusetts Institute of Technology, and the University of Utah. In 1917 he was commissioned a First Lieutenant in the Aviation Section of the U.S. Army Signal Corps and served as a pilot instructor at Scott Field, later being transferred to Martlesham Heath, England. After the War he became the first test pilot for the National Advisory Committee for Aeronautics at Langley Field.

From 1920 to 1922 Mr. Allen was engaged at the Massachusetts Institute of Technology in designing, building, and flying M.I.T. gliders, two of which he flew in competition in France and Germany. He was associate editor of *Aviation* magazine in 1923 and in 1924 returned to the Engineering Division of the Army Air Corps as a civilian test pilot engaged in the performance testing of Army aircraft.

From 1925 to 1929 he was in the U.S. Air Mail service as a pilot, flying the mail on the Cheyenne to Salt Lake City Division, and in 1930 he was employed by the Boeing Aircraft Company as a test pilot. From 1931 to 1935 Mr. Allen served in consulting engineering work on air-line equipment and operating problems and on aircraft-testing problems for several leading manufacturers and transport companies, including Chance Vought Aircraft, Pan American-Grace, Eastern Air Lines, Curtiss-Wright, Douglas, Northrop, North American Aviation, and Lockheed. He had been with the Boeing Aircraft Company since 1939.

Edmund T. Allen was the first recipient of the Octave Chanute Award, established in 1940 by the Institute and given annually to the pilot making an outstanding contribution to the aeronautical sciences. Mr. Allen was selected for this honor because of his outstanding contributions to methods and procedure in flight research in connection with airplane design and operation.

On December 17, 1942, Mr. Allen delivered the Sixth Wright Brothers Lecture of the Institute at Columbia University, New York, commemorating the Thirty-Ninth Anniversary of the first airplane flights made by Orville and Wilbur Wright at Kitty Hawk. His paper "Flight Testing for Performance and Stability" was a description of modern flight-test methods that have been developed from the point of view of the aerodynamicist and aeronautical engineer. During his career, Mr. Allen wrote many articles and technical papers on the aeronautical sciences which were published in periodicals and presented before engineering societies.

Edward Ireland Wersebe

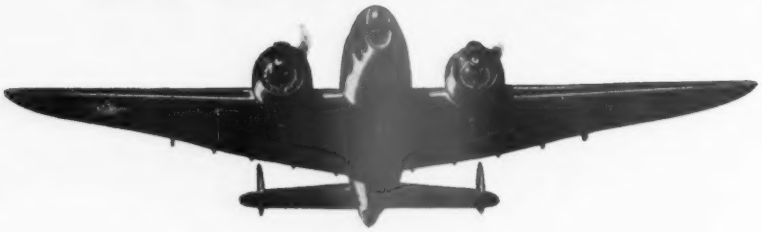
Flying with Mr. Allen and other members of the crew in the bomber accident at Seattle on February 18, 1943, Edward I. Wersebe and two other members of the Institute also lost their lives.

Mr. Wersebe was born November 23, 1914, and was graduated from Amherst College with a Bachelor of Arts degree in 1936, receiving the degree of Master of Aeronautical Engineering from New York University in 1938. His entire aeronautical career was spent with Boeing Aircraft Company, which he joined in 1938 as a Detailer. In 1939 and 1940 he was an Engineer-Aerodynamicist and since 1940 had been a Flight Engineer. He was a member of Beta Theta Pi Fraternity and was Technical Member of the Institute.

Robert Raymond Dansfield

Robert R. Dansfield, a Technical Member of the Institute, was also killed in the Seattle accident. Born in Chicago on December 10, 1915, Mr. Dansfield graduated from the University of Wisconsin in 1938 as a Mechanical Engineer and also attended the Boeing School of Aeronautics from 1938 to 1940. In March, 1940, he became First Officer with United Airlines. At the time of the accident he was in the employ of the Boeing Aircraft Company.

Bruiser



This is the Vega Ventura, a tough looking, tough acting new bomber with some definite family characteristics. It *looks* like the Hudson only bigger. It's sleek and powerful, with stamina in every spar. It acts like the speedy, record-breaking airline Lodestar only faster and more maneuverable. In action it's a *bruiser*, the biggest, hardest-hitting bomber yet designed and produced by Vega. It carries a bellyful of destruction in its whopping bomb bay and throws 50 caliber death from five gun positions.

United States and Royal Air Force pilots can tell much more about this deadly bomber in the days to come, and they *will* in stories of blasted Axis supply lines, smashed Axis tanks and silenced Axis guns.

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Vincent Williams North

Vincent W. North was the fourth member of the Institute whose death occurred in the accident at Seattle. He was born at Miles City, Montana, July 14, 1916, and was graduated with a Bachelor of Science degree in Aeronautical Engineering from the University of Washington in 1939. From June until October, 1939, he did design detailing and drafting at Consolidated Aircraft Corporation in San Diego, Calif., and then became a Junior Aeronautical Engineer at the Matériel Division, Army Air Corps, Wright Field, where his work was checking and calculating airplane performance. He later became an employee of Boeing. Mr. North was a Technical Member of the Institute.

Lt. Col. H. J. Zimmerman

Lt. Col. H. J. (Jack) Zimmerman, M.I.Ae.S., Control Officer at a North Atlantic Base of the Army Air Forces Air Transport Command, was killed on November 2 in an airplane crash in the Gulf of St. Lawrence. In addition to his membership in the Institute, he was a member of the National Aeronautic Association and the Quiet Birdmen.

Col. Zimmerman was born at Freemont, O., June 6, 1906. While a student at Ohio State University he was summoned for active duty with the Army in March, 1928, and was sent for aviation training to the Air Corps Flying School at Kelly Field, San Antonio, Tex., as a flying cadet. He was graduated and commissioned a 2nd Lieutenant in March, 1929, and was on active duty in the air reserve at Langley Field, Va., until June, 1929.

At that time he entered the service of one of the predecessor companies of Transcontinental & Western Air, Inc., as copilot and flew as a Captain on regular schedule for a period of eight years. During that period he assisted in the high-altitude pilot checkout on Stratoliner equipment and also assisted the Civil Aeronautics Administration in research and testing on instrument landing systems. He personally flew the first scheduled airliner into La Guardia field at its opening on December 2, 1939. For the last four years of his service with T.W.A., Colonel Zimmerman was chief pilot of the Atlantic Division, having been appointed Assistant Chief Pilot in December, 1937. As Chief Pilot he was responsible for the training and maintenance of qualifications and technique of all pilots in his division and for the maintenance of operating procedures and studies, as well as tests of new equipment and aids to navigation.

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Personnel Opportunities

This column is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Test Pilot experienced in operation of 1,000 hp., single-engined airplane by large eastern aircraft-engine manufacturer. Engineering training desirable, but not necessary. Persons employed in war production need not apply. Address inquiries to Box 168, Institute of the Aeronautical Sciences.

Engineer, with electrical and mechanical design experience; instrument background; electronic knowledge desirable. **Laboratory Chief,** charge of testing and routine calibration; excellent background in physics, instrument, electrical engineering. Write or apply personally, Personnel Department, Simmonds Aerocessories, Inc., 21-10 49th Avenue, Long Island City, New York.

Electronic and Radio Engineers; Mechanical Engineers familiar with design of small precision equipment, shop practice and tools; **Engineers** familiar with the design of components for electronic equipment; **Technical Men** able to write technical material for instruction books. These positions can be permanent for the right men. Engineers with experience are preferred but applicants, male or female, do not need experience if they have ability to learn and the required aptitude. Salary is open and depends only upon ability and experience. Persons already engaged in war work cannot be considered. Write directly to Chief Engineer, Bendix Radio Division, Baltimore, Maryland, giving complete details of education and experience.

Engineers with experience in aerodynamics, structures, engines, propellers or equipment needed by the Aircraft Engineering Division, C.A.A., well paying Civil Service positions on war work available in New York, N.Y., Kansas City, Mo., Santa Monica, Calif., and Washington, D.C. If now engaged in essential war work, release from present employer will be necessary. Address application directly to Aircraft Engineering Division (A 290), Civil Aeronautics Administration, Washington, D.C.

Engineering Instructors wanted by approved school in Midwest. Furnish qualifications, experience and snapshot in first letter. Address inquiries to Box 152, Institute of the Aeronautical Sciences.

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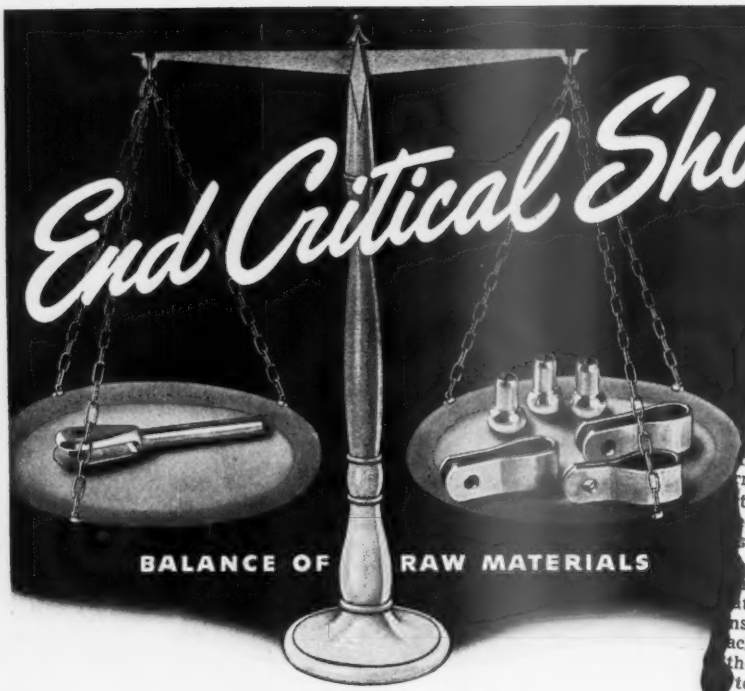
Structures Project Engineer, M.I.T. graduate, with seven years' experience in the design and stress analysis of large airplanes, desires position with medium-sized progressive company with postwar plans. Familiar with Army and Navy requirements. Qualified to handle complete design of metal or plywood airplanes to C.A.A., Army or Navy specifications. Address inquiries to Box 180, Institute of the Aeronautical Sciences.

Aeronautical Engineer, graduated with degree M.S. in A.E., 1941, has since been employed by large southern university as instructor in aerodynamics and airplane design. Has had some practical experience in aircraft construction, maintenance and aerodynamics; holds private pilot license; desires employment as aerodynamicist or in research work. Address inquiries to Box 181, Institute of the Aeronautical Sciences

End Critical Shortages



Note that in spite of its much smaller size, the **BALL WITH SINGLE SHANK SWAGED TERMINAL**, together with the yoke or rod end for use with it, holds to the rated breaking strength of the cable with which it is used.

Of course there is a shortage in the supply of aircraft terminals. Estimates place it at a high figure—and cumulative. The reason is the critical condition of the steel market plus the fact that there is not sufficient automatic equipment available to produce all the A, B, C, and D Swaged Terminals for scheduled production.

You can share in breaking this bottleneck—*you can get earlier delivery yourself*—by adopting **TRU-LOC BALL•TYPE SWAGED TERMINALS** for your controls. Remember, the shortage of steel—and that **BALL•TYPE TERMINALS**, plus yoke or rod end, save over 74% of the metal required to make a type C terminal and save over 60% of the stock needed for a type B.

Don't forget, either, that an automatic can turn out five times as many **BALL•TYPE SWAGED TERMINALS** as either type B or C.

If you need further information, write for complete illustrated folder.

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Ball-Type Terminals Developed by American Chain & Cable Company, Inc. save over 67% Critical Material and Increase by 500% Productive Capacity of Machines Making Terminals

Chicago, Ill., Dec. 9—The backlog of orders for aircraft terminals types, A, B, C, and D, threatens to approach a million a month. The supply of steel used for these terminals is critical, a situation which is complicated by another bottleneck—scarcity of additional machine tools and labor to make up this cumulative shortage.

A type of aircraft terminals, specifically developed to replace types B and C, is being produced by American Chain & Cable Company, Inc., who operate a special manufacturing and engineering Division devoted to the production of aircraft terminals, cable control assemblies and Push-Pull Controls.

These new terminals are called Ball-Type Swaged Terminals. They are made as a Plain Ball, Ball with Single Shank and Ball with Double Shank. The Ball with Single Shank is more commonly used when this terminal replaces a type B or C. American Chain & Cable Company, Inc. also manufacture yoke and rod end stamped fitting for use with these Ball-Type Swaged Terminals.

Save Steel.

The aircraft industry, and all those who use steel, will be interested in the fact that whereas 1,000 Type C Terminals for ⅛" cable require the use of 188 lbs. of bar stock, 1,000 of the new Ball with Single Shank Terminals for the same cable need only 18.8 lbs. of bar stock and 1,000 yokes for this fitting require only 42.6 lbs. of less critical stock for their stamping—a total of 61.4 lbs.

Save Machine Hours.

Another reason for the interest of war industry in the production of these Ball-Type Terminals lies in the fact that in one 8-hour shift an automatic can produce five times as many of the newer terminals as the same machine can produce of Type C terminals in the same number of hours.

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BRIDGEPORT • CONNECTICUT

Institute of the Aeronautical Sciences Eleventh Annual Meeting

The Eleventh Annual Meeting of Members of the Institute of the Aeronautical Sciences, Inc., was held in New York on the last Wednesday of January, as required by the Constitution and By-Laws, in the Pupin Physics Laboratories Building, Columbia University, at 5:00 p.m. on January 27, 1943. Dr. Hugh L. Dryden, President of the Institute, presided and Robert R. Dexter acted as secretary of the meeting.

Fred E. Weick, appointed by the President as Teller of proxies, reported that he had received and counted 377 valid proxies for voting at the Annual Meeting—a quorum of the voting members.

Frank W. Caldwell, on behalf of the Nominating Committee, placed in nomination the following members for election to vacancies on the Council for a three-year period each: C. S. Jones, P. R. Bassett, James H. Kimball, and John C. Leslie. On motion duly made, seconded, and carried, they were unanimously elected. The following were nominated and elected in like manner to serve on the Advisory Board for a term of one year: John D. Akerman, Lawrence D. Bell, Don R. Berlin, Lyman J. Briggs, William K. Ebel, Jack Frye, P. G. Johnson, Th. von Kármán, J. H. Kindelberger, F. K. Kirsten, Paul Kollsman, Arnold M. Kuethe, William Littlewood, Thomas A. Morgan, Richard W. Palmer, W. A. Patterson, A. E. Raymond, F. W. Reichelderfer, J. T. Trippe, J. G. Vincent, and Edward P. Warner.

J. P. Van Zandt placed in nomination the following past-presidents of the Institute to serve as the Nominating Committee for 1943: Frank W. Caldwell, Hall L. Hibbard, Charles L. Lawrance, George W. Lewis, and T. P. Wright. On motion duly made, seconded, and carried, they were elected.

The Annual Reports of the President, Treasurer, Secretary, and President of the Aeronautical Archives were read and approved as follows:

President's Annual Report, 1942

As the first decade of the history of the Institute closed, the continued progress of the Institute was accelerated by two gifts of large significance to the Institute. The possibilities of using the beautiful buildings and grounds of the Daniel Guggenheim Estate after the War open opportunities for service which can place the Institute in a fortunate position. With Glenn L. Martin's generous endowment, plans may be made which would otherwise be impossible. To Mrs. Guggenheim and Mr. Martin, as well as Mrs. Landauer, Mr. Fairchild, and Mr. Warner, your President formally expresses the gratitude of the Institute for their generous gifts.

As will be seen from the Secretary's report, the Institute's membership has grown steadily during 1942. Our 49 branches have functioned with increasing interest of local members. To the officers and committees of these Branches we are indebted for their excellent service and cooperation. We hope that we can assist them in their work more as funds become available for such broad organization work.

Our Archives have rendered an ever expanding service to our membership and to the public. Both of the libraries in New York and in Los Angeles have grown so fast that the problem of housing is becoming one of the principal concerns of your officers. Thousands of books have been loaned by mail so that those who cannot come to the libraries can make use of them freely. Our card files and biographic and subject indexes are now regarded as the most complete in the world.

The Journal of the Aeronautical Sciences has maintained its high standards of technical excellence under the present restrictions of censorship.

The Aeronautical Engineering Review has been accepted as a medium for informing our members of the progress of the aircraft profession. This has caused its growth to be phenomenal and the Institute's members are now receiving a double service, which gives them advanced scientific papers and also keeps them informed as to the current books, articles and releases in condensed readable form.

Your Treasurer's report shows that while the activities of the Institute have broadened greatly the budget has not been increased in the same proportion. It is also interesting to note that all funds entrusted to the Institute's keeping are all at a higher valuation than when they were received.

The Pacific Aeronautical Library, which was started in 1940 with the cooperation of the aircraft companies in the Los Angeles area, is rendering a valuable service and is appreciated by members and the aircraft industry.

To the many generous donors whose gifts have been publicly acknowledged from time to time in our publications, I again express our appreciation. Probably no society has ever been so fortunate in its early years as the Institute. It places an obligation on those who are charged with the management of its affairs to see that their trusteeship is carefully supervised.

I am especially grateful to the officers, the Council and the staff of the Institute for their cooperation during the year. Fortunately, the Institute is so organized that it is possible for it to have its President located on the other side of the country.

We on the Pacific Coast appreciate the honor of having the Presidency of such a thriving society bestowed on one of our group every other year.

To the aeronautical industry, the Institute is grateful for its support and interest. The ever increasing importance of aviation in the War will make heavy demands on all scientific societies. As the membership of the Institute is almost entirely engaged in the war effort, we feel that when the record of the part the airplane has taken in this global conflict is made the aeronautical scientists and engineer will have a foremost position.

Hall L. Hibbard

The Treasurer's Annual Report, 1942

The audited statement of the Institute, while showing an increase in assets from $116,911.15 last year to $768,-264.32 this year, gives only a part of the fortunate position of the Institute. The market value of the securities owned by the Institute is $13,829.25 higher than we carry them on our books. There is $12,500 more due from Paul Kollsman, which will be received in 1943 and 1944. Glenn L. Martin has agreed to give the Institute 20,000 more shares of stock of his company during the next four years. The present market worth of this stock is $390,000. If these were included, the net worth of the Institute would be $1,187,593.57. In this total is included the assessed valuation of the estate given to the Institute by Mrs. Guggenheim, the actual value of which can only be determined by future conditions.

(*Continued on page 151*)

Tin fish swim only on the home stretch

Aerial torpedoes have to swim only a few hundred yards on their own power. But first they must be flown hundreds of miles to get within striking range.

How far the tin fish can be carried depends on the range of our planes. Range comes from extra power per pound of weight, and therefore is largely a matter of gasoline quality. With high-octane gasoline available, our engines were designed to produce more power—more miles—per gallon of fuel.

The "fighting grade" gasoline which the American petroleum industry is turning out in vast quantity for our Army, Navy and Allied planes is a triumph of chemical and engineering ingenuity. Every gallon contains Ethyl fluid to boost the already high octane rating still higher; to put in an extra punch.

Some 4000 people today are employed in the manufacture of Ethyl fluid. To all of them the sight of a plane in the sky, the sound of an engine overhead, is a reminder that their time and skill are needed.

ETHYL CORPORATION

Chrysler Building, New York City

Manufacturer of Ethyl fluid, used by oil refiners to improve the antiknock quality of aviation and motor gasoline.

INSTITUTE OF THE AERONAUTICAL SCIENCES, INC.

For the Fiscal Year October 1, 1941, to September 30, 1942

Consolidated Balance Sheet

ASSETS

General Fund Assets:		
Cash on Deposit and Petty Cash		$ 4,511.49
Accounts Receivable		1,738.12
Deposits and Advances		755.75
The Benefactor Membership Fund:		
U.S. Treasury Bonds and War Bonds (Market Value $23,155.00)		22,000.00
Office Furniture & Equipment	$18,791.28	
Less: Reserve for Depreciation	10,133.40	8,657.88
Prepaid Expenses		879.90
Library—Books, Prints, Models, Pictures, etc.		1.00
Aeronautical Index		1.00
Total General Fund Assets		$ 38,545.14
Investment of Restricted Funds:		
The Sherman M. Fairchild Publication Fund:		
U.S. Treasury Bonds at par value (Market Value $20,050.00)	$20,000.00	
Cash on Deposit	4,816.01	$ 24,816.01
The R. H. Fleet Fund:		
U.S. Treasury Bonds at par value (Market Value $10,025.00)	10,000.00	
Cash on Deposit	111.95	10,111.95
The Paul Kollsman Fund:		
U.S. Treasury Bonds at par value (Market Value $41,102.50)	$41,000.00	
Cash on Deposit	11,001.59	
Accounts Receivable	$581.58	
Less: Accounts Payable	83.17	498.41 52,500.00
The Vernon Lynch Award Fund:		
Melville Shoe Corp. Stock (Market Value $7,177.00)	$ 5,004.00	
Peoples Drug Stores, Inc. Stock (Market Value $8,460.00)	7,272.50	
Cash on Deposit	1,130.56	13,407.06
The Minta Martin Aeronautical Endowment Fund:		
Glenn L. Martin Co. Stock (Market Value $85,000.00)	$77,500.00	
Cash on Deposit	15,324.53	
Petty Cash	50.00	92,874.53
Property Fund:		
Daniel Guggenheim Park—Assessed Valuation		517,300.00
The Sylvanus Albert Reed Award Fund:		
U.S. Treasury Bonds at par value (Market Value $10,962.50)	$10,000.00	
Cash on Deposit	909.61	10,909.61
The Lawrence Sperry Award Fund:		
U.S. Treasury Bonds at par value (Market Value $7,673.75)	$ 7,000.00	
Cash on Deposit	800.02	7,800.02
Total Restricted Fund Assets		$729,719.18
Total Assets*		$768,264.32
* Pledges for future gifts have been made by donors of:		
The Paul Kollsman Fund		$ 12,500.00
The Lawrence Sperry Award Fund		3,000.00
Unrealized appreciation on investments		13,829.25
		$ 29,329.25
The Minta Martin Aero. Endowment Fund: 20,000 shares Glenn L. Martin Co. stock present market value—approx.		390,000.00
Assets as listed above		768,264.32
Grand Total Assets		$1,187,593.57

LIABILITIES, FUNDS AND UNEXPENDED INCOME

General Liabilities:		
Accounts Payable		$ 7,759.67
Deferred Income:		
Unearned Dues	$13,200.25	
Unearned Subscriptions	3,158.00	16,358.25
Unexpended Income:		
Balance October 1, 1941	$10,827.29	
Unexpended Income—For Year Ended September 30, 1942	3,599.93	14,427.22
Total General Liabilities		$ 38,545.14
Restricted Funds:		
For all principal sums and unexpended income balances see "Assets"		
Total Restricted Funds		729,719.18
Total Liabilities, Funds and Unexpended Income		$768,264.32

Statement of Income and Expenses

INCOME

Dues (Members & Corporate Members)		$ 47,346.11
Entrance Fees		1,230.00
Benefactor & Donor		700.00
Miscellaneous		1,266.59
		$ 50,542.70
Excess of Income over Expenses:		
Journal of the Aeronautical Sciences	2,303.06	
Aeronautical Engineering Review	2,068.58	
Total Income		$ 54,914.34

EXPENSES

Administration Clerical & Accounting		$ 23,627.77
Award Expenses		1,037.55
Office Expenses, Supplies, Printing, etc.		6,344.24
Travel		1,869.58
Rent		1,830.00
Miscellaneous		1,509.68
Depreciation		1,380.57
Maintenance of Aeronautical Archives		8,564.46
Net Cost of Library		3,363.65
Net Cost of Pacific Aero. Library		1,786.91
Total Expenses		$ 51,314.41
Net Unexpended Income for the Year Ended September 30, 1942		$ 3,599.93

Detail of Journal and Review Income and Expense

Journal

INCOME

Subscriptions (Members & Subscribers)		$ 27,260.21
Reprints		789.75
Income		$ 28,049.96

EXPENSES

Administration, Editorial & Accounting	$ 9,890.95	
Engraving Printing & Postage	9,184.40	
Office Expenses, Supplies, Printing, etc.	2,551.34	
Travel & Miscellaneous	1,599.93	
Rent	1,830.00	
Depreciation	690.28	
Expenses		$ 25,746.90
Excess of Income over Expenses—See Institute Income		$ 2,303.06

Review

INCOME

Advertising Revenue	$ 48,329.13	
Subscriptions (Members & Subscribers)	7,276.11	
Income		$ 55,605.24

EXPENSES

Administration, Editorial & Accounting	$ 22,689.70	
Agencies & Representatives' Commissions	8,738.58	
Engraving, Printing & Postage	17,052.80	
Travel, Promotion & Miscellaneous	3,255.58	
Rent	1,800.00	
Expenses		$ 53,536.66
Excess of Income over Expenses—See Institute Income		$ 2,068.58

The assets of the Institute are carried at book values. These are $13,829.25 below the market value. The libraries and collections of the Institute are shown on the books as valued at $1.00 each. The Indexes were assembled by the Work Projects Administration at an expense of over $300,000. The Paul Kollsman and Pacific Aeronautical libraries have over 9,000 books and represent a replaceable value of over $25,000. The collections of aeronautical prints, book plates, medals, insignia, medallions and airplane models contain so many rare and irreplaceable parts that no estimate of their value could be made.

Sherman M. Fairchild gave to the Institute antique furniture, rugs and tapestries for use in the mansion at Daniel Guggenheim Park. The appraised value for insurance purposes is over $25,000.

On Every Battlefront—

You'll find **N-A-X** *9100 Series of Alloy Steels*

There is hardly a theater of war today where N-A-X 9100 Series is not at the beck and call of our armed forces. If you looked for it, you wouldn't find it. It's there, though, in tanks, bombs, trucks, anti-aircraft and other types of guns and armament. And there it will stay until Victory is won.

N-A-X 9100 Series is an outstanding achievement of Great Lakes engineers and metallurgists. (*It is basically an alloy steel, with all strategic elements carefully balanced and held to an absolute minimum.*) It is being supplied in two general grades, with and without molybdenum, all other components of the analysis being held constant.

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Detroit, Michigan
Sales Offices in Principal Cities

NATIONAL STEEL

Division of
NATIONAL STEEL CORPORATION
Executive Offices · Pittsburgh, Pa.

(*Continued from page 147*)

The great libraries, collections and files of the Aeronautical Archives are carried at $1.00 on our books. These cost several hundred thousand dollars and much that we own could not be replaced at any cost.

The rate of depreciation that is taken each year is indicated by the reserve of $10,133.40 against cost of furniture and fixtures of $18,891.28.

Again, it is pleasing to report that all of the funds entrusted to our care have higher market values than at the time they were given to the Institute.

The libraries of the Institute are rendering an increased service each year, both in New York and Los Angeles. The Paul Kollsman Library has loaned 3,151 books by mail. The larger part of the cost of maintaining libraries comes from gifts. The endowments and gifts of collections to the Institute may be traced directly to the maintenance of these libraries.

The great increase in size of the AERONAUTICAL ENGINEERING REVIEW will be paid for by advertising and it is hoped that, as this magazine was started to supplement the library services, it may soon contribute to their upkeep.

Again the Institute has operated within its income. The excess of income over expenses for the year was $3,599.93 making the total surplus $14,427.22.

The liabilities of the Institute are current bills. Discounts are taken from all bills as earned.

The books are examined by a firm of public accountants and they state that the statements of income and expenses fairly present the results of the operation of the fiscal year ending September 30, 1942.

EARL D. OSBORN

So that the financial statement for 1941–1942 may be compared with that of previous years and the increases noted, the following table of assets and unexpended income is presented.

	Total Assets	Unexpended Income by Year	Total Unexpended Income
1933	$ 1,176.92	$ 705.01	$ 705.01
1934	7,717.18	3,465.63	4,170.64
1935	6,338.22	462.48	4,633.12
1936	20,906.90	261.43	4,894.55
1937	23,497.66	408.14	5,302.69
1938	35,776.91	281.93	5,584.62
1939	46,149.64	918.37	6,502.99
1940	67,995.56	1,828.56	8,331.65
1941	101,583.40	2,495.64	10,827.29
1942	768,264.32	3,599.93	14,427.22

The Secretary's Annual Report, 1942

At the end of its tenth year the Institute has passed the 5,000 mark in total membership. The membership by grades as of January 1, 1943, is as follows:

Honorary Members	12
Honorary Fellows	18
Fellows	148
Associate Fellows	429
MEMBERS	745
Industrial Members	178
Technical Members	2,060
Total graded members	3,590
Affiliates	33
Student Members	1,580
Total Membership	5,203

During the calendar year, 827 new members were admitted in grades above those of Affiliate and Student Member. About half of these were transferred from previous Student Membership to Technical Membership and half were admitted to this and higher grades of membership by application to the Admissions Committee. The membership was decreased by the death of 13 members, resignations of 14, and 427 dropped from the list of enrolled members. In addition to some dropped for nonpayment of dues, this last figure includes a considerable number of former members whose present status and whereabouts are at present unknown. All who were in enemy or enemy occupied territory are not included in present membership totals, since their status cannot be determined until after the war.

Subtracting these deletions from the total of new members leaves a net increase of 373 graded members for the year 1942. The enrollment of Student Members, who are admitted and renewed on a yearly basis, was higher by 636 Student Members on January 1, 1943, than the enrollment of twelve months previous. In the new grade of Affiliate, 33 had been admitted by January 1, 1943. Thus, on this date, there was a net increase in enrollment of 1,042 members in all grades since January 1, 1942.

The new grade known as Affiliate was established last year for "persons who are engaged in aeronautical work or work related to aeronautics who wish to participate in the activities of the Institute and receive the services specified by the Council for this grade of membership." They can receive the AERONAUTICAL ENGINEERING REVIEW and attend meetings but are not qualified to vote on Institute matters or to hold office in Institute Section organizations. This grade has provided means by which many who are interested in the programs of our organized Sections in aeronautical centers may benefit from meetings and publications even though not entitled to take part in the guidance of policy and activities of the Institute. A considerable number of applications for Affiliates have been received through Section organizations for action after January 1.

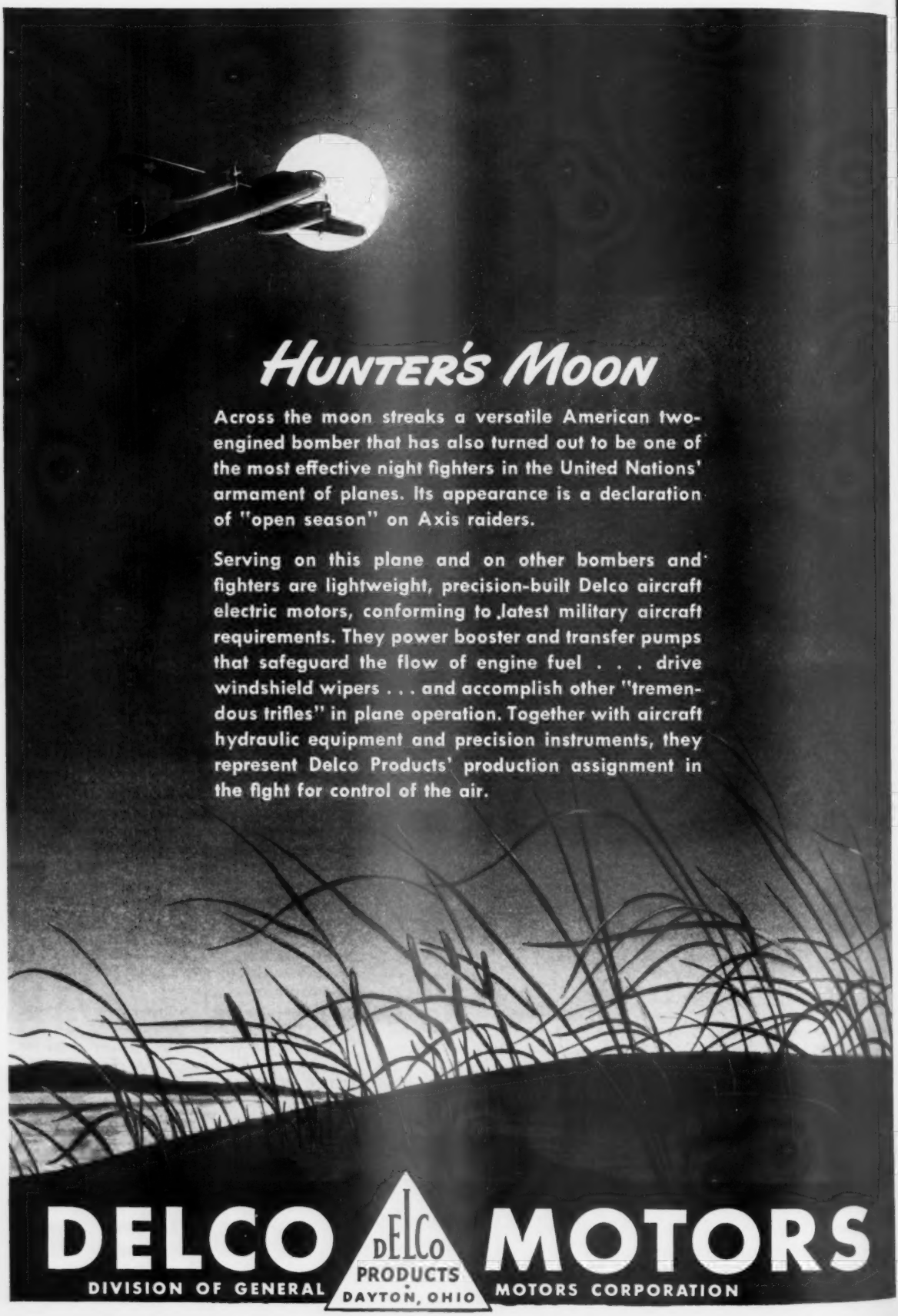
Of the local Sections of the Institute, the San Diego Section deserves special mention for the splendid program of meetings arranged by its officers and the effort put forth in enlarging the membership in the region. Other active Sections that have held meetings during the year are located in Akron, Detroit, Los Angeles, Notre Dame (Indiana), and Seattle. A new Section is now being organized in Buffalo.

The expansion and intensification in aeronautical courses given in the schools and colleges of the country in the past year have been reflected in the number of Student Members in the Institute, which is now 1,580 as compared with 944 at this time last year. This is already greater than the total enrollment of 1,410 at the end of the last Student Membership year, August 31, 1942, and will be increased further before the current Student Membership year ends in August, 1943. There are Student Branches of the Institute in 43 schools and colleges. During the year a total of 160 meetings were reported by Branch secretaries.

Changes have been made in the rules for Student Branches to adapt their activities to condensed educational schedules and changed graduation dates. Those students who complete the equivalent of former four-year courses in aeronautical engineering are admitted to Technical Membership upon graduation. Students taking special short courses are permitted to participate in Student Branch activities as Branch Associates and do not hold Student Membership in the Institute. However, they may join the Institute as Affiliates after completion of their studies.

During 1942 the list of Corporate Members of the Institute was increased by 31 companies, making a total of 104, not counting any subsidiary divisions, at the end of the year. The wide representation of aeronautical companies and allied industries in the Corporate Membership is shown by the list published in each issue of the JOURNAL OF THE AERONAUTICAL SCIENCES. The support of these affiliated companies is an evidence of the esteem in which the Institute is held.

The end of the year covered by this report coincides with the termination of my service, for the time being at least, on the staff and as an officer of the Institute, as I have submitted my resignation, effective January 1, 1943, to go into military service. In breaking off an association with this organization which has covered the past nine years—three of them as your Secretary—I am, of course, happy that my report at this time can again record the continued advancement and growth of the Institute. I am confident that its future development, which I shall follow with great personal interest as a member, will go forward as before in providing ever more


HUNTER'S MOON
Across the moon streaks a versatile American two-engined bomber that has also turned out to be one of the most effective night fighters in the United Nations' armament of planes. Its appearance is a declaration of "open season" on Axis raiders.
Serving on this plane and on other bombers and fighters are lightweight, precision-built Delco aircraft electric motors, conforming to latest military aircraft requirements. They power booster and transfer pumps that safeguard the flow of engine fuel . . . drive windshield wipers . . . and accomplish other "tremendous trifles" in plane operation. Together with aircraft hydraulic equipment and precision instruments, they represent Delco Products' production assignment in the fight for control of the air.
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DAYTON, OHIO
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valuable service to the aeronautical profession.

Mr. Robert R. Dexter, whom the Council has elected to succeed me as Secretary and who presents this report on my behalf, has been on the Institute staff for the past seven years and for some time has been in charge of arrangements for technical meetings and the publication of technical papers in our JOURNAL and REVIEW. He is an excellent choice for this position and I am confident that he will carry out its responsibilities conscientiously and successfully.

I take this opportunity to convey my best wishes for the continued progress of the Institute and to express appreciation to the Council members, officers and staff with whom it has been my good fortune to have worked in such a pleasant association over the past years.

C. E. SINCLAIR

Report of President of the Aeronautical Archives, 1942

There are five divisions of the Aeronautical Archives: The Burden Library, The Paul Kollsman Library, The Pacific Aeronautical Library, the Aeronautical Indexes and Collections, and the AERONAUTICAL ENGINEERING REVIEW.

The Paul Kollsman Library was established in 1940 when Paul Kollsman and the Square D Company set up a fund of $50,000 for the organization of a free lending library. Of this amount, $10,000 was used in organizing the Library. Last year, Mr. Kollsman made an additional grant of $12,500 and will increase this by $12,500, thereby providing a permanent fund of $65,000. The income from this endowment, together with a yearly contribution of $5,000 from the Square D Company to the Institute which is alloted for the upkeep of the Library will be used for the maintaining of the Library.

During the year The Paul Kollsman Library membership increased from 1,441 to 2,105, adding a total of 664 new members. The number of books loaned during this period was 1,515, and the total number loaned since the Library was established is 3,151.

On October 1, 1941, the Institute opened The Pacific Aeronautical Library in Hollywood, Calif. The establishment of the new library was made possible by a grant from The Paul Kollsman Fund which is to be used for the purchase of books. The Library was an outgrowth of a plan presented by a committee of librarians from the various aircraft companies in the West Coast area. Ten companies contribute to the support of the Library. In addition to the loan of books and magazines to the libraries of the aircraft companies, the facilities of the Library are available to the public for reference and reading. During the first year of its operation, 1,735 books and magazines were loaned.

Books Added to the Libraries

During the year 1,880 books were added to The Paul Kollsman Library. Of these, 280 were purchased, 304 were review copies of new books sent to the AERONAUTICAL ENGINEERING REVIEW by publishers, 22 were received on advertising exchange, 72 were accessioned as bound periodicals, and 1,202 were gifts.

The W. A. M. Burden Library received an additional 230 bound volumes of periodicals and 35 new books.

During the first year of its operation, The Pacific Aeronautical Library accessioned 1,426 books. Of these, 220 were purchased, 250 were received on advertising exchange through the Institute in New York, and 956 were gifts.

The Institute Libraries received 3,571 books in all during the year, bringing the total number of books in them to 19,871. The Paul Kollsman Library contains 7,184, The W. A. M. Burden Library, 11,261, and The Pacific Aeronautical Library, 1,426.

Reference Service

The Aeronautical Archives received 606 visitors 1,259 times during the year. The Archives include the facilities of The Paul Kollsman Library and The W. A. M. Burden Library. These 606 persons used 4,117 books and magazines, or an average of 3.27 books and magazines per visit. The telephone calls for information received by the Archives numbered 831, and 488 persons visited and inspected the Libraries without making use of the Archives for reading purposes.

The Pacific Aeronautical Library received 1,319 readers during the year and answered 407 telephone calls for specific information. The number of persons who inspected the Library without using it for reading purposes was 116. Figures on the use of books in the reading room of The Pacific Aeronautical Library are not kept, as it is an open shelf collection and readers consult the books directly.

Late in the summer The Pacific Aeronautical Library undertook a periodical indexing project, underwritten by the Aircraft War Production Council of the West Coast. Additions to the staff were secured, equipment for printing index cards was installed, additional magazines were added to the Library, and early in October the mailing of index cards to the participating companies and the Institute was begun.

Gifts to the Archives

It is not possible in this report to give individual appreciation to all the friends of the Archives who made contributions.

The gifts received during the year included, among other, 123 books from England. These were purchased from a fund of $1,000, which was presented by Sir Richard Fairey in 1941. Mrs. Bella C. Landauer gave more than 300 books, including her collection of early American childrens' books of aeronautical interest, a collection of dime novels about flying machines, and aviation fiction for boys and girls. From January to March, 1942, an exhibit consisting of selections from this material was displayed in the Archives. In March, 1942, an exhibition of aeronautical prints, music, posters, book plates, dime novels, and books was held at the University Club in New York. A large part of this material was taken from the collections of Mrs. Bella C. Landauer, augmented by prints from the extensive Harry F. Guggenheim collection. Edward P. Warner gave 300 additional books from his private library, continuing his large gifts of the previous year. Lester D. Gardner gave more than 30 additional books and added to the collections of Christmas cards, clippings, and other aeronautica he had previously given. Mrs. E. S. Harkness presented a photostat copy of a letter in her possession, written in Paris by Benjamin Franklin to Dr. Ingenhaus, of Vienna, on January 16, 1784, on the subject of balloons in war. George R. Cooley, of Albany, New York, gave to the Archives an original of a book published in that city in 1825 entitled *Memorial on the Upward Forces of Fluids, and Their Applicability to Several Arts, Sciences and Public Improvements*, by Edward Charles Genet, known as "Citizen" Genet, the minister of the First French Republic to the United States and a resident of this country from 1793 to his death in 1834. A copy of *Aerial Navigation*, by D. Caulkins, M.D., published in Toledo, O., in 1825 was presented by Miss Leona Replogle of that city. Prof. F. K. Kirsten donated a bound photostat copy of *Newly Discovered Properties of the Cycloid, or the Curve of Unknown Force*, by Jerry Wrenlow, published in Seattle in 1898. Charles L. Lawrance presented a *Prospectus of the Aeronautic Association*, London, 1837. Griffith Brewer presented a complete set of the British patents entitled *Abridgments of Specifications, Aeronautics Section*, from 1855 through February 16, 1939. The Eclipse Aviation Division of the Bendix Aviation Corporation gave 1,372 unbound periodicals. Support from aircraft companies included gift subscriptions and back files of 20 additional house organs, a substantial contribution from these companies to this important part of the collections of source materials.

A summary of the statistical data on the Libraries is given below and on the following page.

Statistics

October, 1941–September, 1942

The Paul Kollsman Library

Total Library Membership	2,105
Total Number of Books Loaned	3,151
New Members During Year	664
Books Loaned During Year	1,515

The Pacific Aeronautical Library

Days Open	271
Books and Periodicals Loaned	1,735
Readers	1,319
Telephone Calls for Information	407
Total Users	1,726
Visitors	116

The W. A. M. Burden Library

Days Open	271
Books Used in Reading Room	4,117
Readers	1,259
Telephone Calls for Information	831
Total Users	2,090
Visitors	488

The card index of the Archives contains over two million classified cards prepared by the Work Projects Administration. The biographic files of the Archives contain over 16,000 biographic sketches of persons engaged in aeronautical activities in all parts of the world. The subject files are expanded each year by the addition of clippings from newspapers and magazines. The indexes and subject files are used daily by members and others interested in securing aeronautical information.

The AERONAUTICAL ENGINEERING REVIEW was started with a grant from the Paul Kollsman fund to keep the aeronautical profession informed about current books, periodicals, and other publications. It has rendered a valued service.

The collections of prints, models, and relics were greatly increased by the gift of Mrs. Bella C. Landauer of her rare collection of aeronautical clocks, fabrics, china, and relics.

The Aeronautical Archives can now be regarded as the most comprehensive source of aeronautical information in the country.

LESTER D. GARDNER

Companies Whose Representatives Used the Archives in Person, 1942

Manufacturing and Business Firms

Aero Insurance Underwriters
Air Cargo, Inc.
Aircraft Industries Corporation
Airsealand Aircraft, Inc.
American Airlines, Inc.
American Cyanamid & Chemical Corporation
American Eastern Corporation
American Export Airlines, Inc.
George S. Armstrong and Company, Inc.
Atlantic Diesel Corporation
S. Frederick Auerbach Company
N. W. Ayer & Son, Inc.
Beaumont and Hohman, Inc.
Bell Telephone Laboratories, Inc.
Bendix Aviation Corporation
BG Corporation
Boeing Aircraft Company
H. A. Bruno and Associates
Brewster Aeronautical Corporation
British Overseas Airways Corporation
Brown Brothers
Canadian Pacific Railway Company
Cecil and Presbrey, Inc.
Century Woven Label Company
Chadbourne, Wallace, Parke & Whiteside
Chandler-Evans Corporation
Charleston National Bank
Chemical Bank and Trust Company
John T. Clark & Son
Coverdale & Colpitts
Curtiss-Wright Corporation
Denker, Johnson & Fleck
Dickie-Raymond, Inc.
Dowty Equipment Corporation
Eastern Air Lines, Inc.
Ebasco Services, Inc.
Electric Boat Company
Equi-Flow, Inc.
Ethyl Gasoline Corporation
Executive Engineers, Inc.
Federal Telegraph Company
Fleetwings, Inc.
F N Chemical Manufacturing Company
Norman Bel Geddes & Company
General Electric Company
General Floor Refinishing Company
General Motors Corporation
Jonathan Goldstein
Grumman Aircraft Engineering Corporation
Hinson-O'Donnell Advertising, Inc.
Industrial Container Corporation
Intercontinent Corporation
M. W. Kellogg Company
Kollsman Instrument Division, Square D Company
Arthur Kudner, Inc.
Langley Aviation Corporation
Lawrance Engineering and Research Corporation
Lear Avia, Inc.
Lehman Corporation
Liberty Mutual Insurance Company
Ludington-Griswold Laboratories
Warren McArthur Corporation
McCann Erickson, Inc.
Manhattan Foundation, Inc.
The Glenn L. Martin Company
National Broadcasting Company
New Britain Machine Company
New York Central Railroad
Newell Emmett Company
T. A. O'Rourke, Inc.
Pan American Airways System
Pan American-Grace Airways, Inc.
Parker & Dobson, Inc.
Penick & Ford, Ltd., Inc.
Pennsylvania Railroad
Pope and Vernum, Inc.
Joshua B. Powers, Inc.
Pratt, Read & Company, Gould Aeronautical Division
Radio Corporation of America
Ranger Aircraft Engines Division, Fairchild Engine & Airplane Corporation
Charles Dalles Reach Company
Republic Pictures Corporation
Rickard and Company
RKO Radio Pictures, Inc.
Robins Conveying Belt Company
Robsjohn-Gibbings, Ltd.
Rockefeller Center, Inc.
Schmieg & Kotzian, Inc.
Shell Oil Co., Inc.
Simmonds Aerocessories, Inc.
Skydyne, Inc.
L. C. Smith & Corona Typewriters, Inc.
Snead & Company
Socony-Vacuum Oil Company, Inc.
Spence, Windels, Walser, Hotchkiss & Angell
Sperry Gyroscope Company, Inc.
Sperry Products, Inc.
Standard Oil Company of New Jersey
Taylor and Lovejoy
Walter Dorwin Teague
The Texas Company
Transcontinental & Western Air, Inc.
United Air Lines Transport Corporation
United States Rubber Company
Vought-Sikorsky Aircraft Division, United Aircraft Corporation
Vultee Aircraft, Inc.
Waugh Equipment Company
J. G. White Engineering Corporation
Winemiller and Miller, Inc.
York Aircraft Company

Publications and Publishers

Aero Digest
Aeronautics
Aircraft Publications
Air Force
Air News and Air Tech
Air Trails
American City Magazine Corporation
American Mercury
American Weekly
Architectural Record
Associated Press
Automotive and Aviation Industries
Aviation
Building America
Christian Science Monitor
Click, Inc.
Collier's, the National Weekly
Crowell-Collier Publishing Co.
Devin Adair Publishing Co.
Doubleday, Doran & Co.
Esquire, Inc.
Flying Aces Magazine
Flying and Popular Aviation
Flying Cadet

Greenberg, Publisher
The Greystone Press, Inc.
Grolier Society
Jordanoff Aviation Company
Life Magazine
Look Magazine
Robert M. McBride Company
Julian Messner, Inc.
Model Airplane News
National Aeronautics Council
New Haven Register
New York Herald Tribune
New York Post, Inc.
New York Times
North American Press Service
PM Newspaper
Popular Science Monthly
Readers Digest
Reinhold Publishing Corporation
Rockefeller Center Magazine
S.A.E. Journal
Saturday Evening Post
Skyways
Sportsman Pilot
Text Research and Education, Inc.
Three Lions (Publishers)
Time, Inc.
United Press Association
Wall Street Journal
The H. W. Wilson Company
William H. Wise and Company

Schools and Universities

Academy of Aeronautics
Airlines War Training Institute
Ballston Spa, N.Y., Public Schools
Benjamin Franklin High School
Brooklyn College
Brooklyn Technical High School
Bryant High School
Cardinal Hayes High School
Colgate University
College of the City of New York
Columbia High School (South Orange)
Columbia University
A. B. Davis High School
Eastern Aircraft Instrument School
Freeport, L.I., Public Schools
George County, Maryland, Public Schools
Goose Creek, Texas, Public Schools
Illinois Institute of Technology
Long Island City High School
National Technical Institute
New York City Board of Education
New York School for Aircraft Instruments
New York University
Polytechnic Institute of Brooklyn
Princeton University
Stinson School of Aviation
Syracuse University
Technicians Institute
University of Florida
University of Kentucky
University of Pennsylvania
University of Washington
Vassar College
Webb Institute of Naval Architecture
Yale University

Government Agencies

New York Municipal Airport
New York State Department of Public Works
Royal Australian Air Force
Royal Canadian Air Force
U.S. Army
U.S. Board of Economic Warfare
U.S. Congress, Senate Subcommittee on Safety in Air
U.S. Coordinator of Inter-American Affairs
U.S. Civil Aeronautics Administration
U.S. Department of Commerce
U.S. Department of Justice
U.S. National Advisory Committee for Aeronautics
U.S. Navy
U.S. Office of War Information
U.S. Securities and Exchange Commission
U.S. Work Projects Administration

Organizations

American Bureau of Urban Transportation
American Society of Civil Engineers
Associated Hospital Service of New York
Battelle Memorial Institute
Council on Foreign Relations
Engineering Societies Library
Manufacturers Aircraft Association, Inc.
Museum of Modern Art
National Aeronautic Association
New York Museum of Science and Industry
Rochester Public Library
Women Flyers of America

Awards and Officers

The Secretary presented the following list of honors conferred by the Institute in 1942:

The Sylvanus Albert Reed Award to Igor I. Sikorsky.

The John Jeffries Award to Dr. Edward C. Schneider.

The Robert M. Losey Award to F. W. Reichelderfer.

The Octave Chanute Award to A. Lewis MacClain.

The Lawrence Sperry Award to Edward C. Wells.

(Citations for the above awards are published in the account of the Honors Night Dinner in this issue of the REVIEW.)

The Wright Brothers Lecture was presented by E. T. Allen on December 17, 1942, on the subject, "Flight Testing for Performance Stability."

Fellowship in the Institute to Frederic Flader, Rudolph F. Gagg, Paul E. Hovgaard, Clarence L. Johnson, Arthur L. Klein, John G. Lee, William T. Schwendler, T. E. Tillinghast, P. V. H. Weems, and John B. Wheatley.

Honorary Membership in the Institute for the year 1943 conferred by the Council upon Rear Admiral John S. McCain, W. A. M. Burden, and T. P. Wright.

On motion duly made, seconded, and carried, a resolution was passed expressing the appreciation of the Institute to Pres. Nicholas Murray Butler and Dean George B. Pegram, of Columbia University; the University of Southern California, and the Engineering Societies of Detroit for the cooperation and gracious hospitality extended to the Institute.

On motion duly made, seconded, and carried, a resolution was passed expressing the appreciation of the Institute to the Air Forces Section, Review Branch, Bureau of Public Relations, War Department, for its cooperation and technical assistance that made possible open meetings in the Technical Sessions of the Eleventh Annual Meeting.

The Secretary announced the Officers of the Institute for 1943 elected by the Council at its meeting on December 30, 1942, as follows:

President—Hugh L. Dryden
Vice Presidents—J. L. Atwood
E. R. Breech
Sherman M. Fairchild
Earl D. Osborn
Executive Vice-President—Lester D. Gardner
Treasurer—Elmer A. Sperry, Jr.
Secretary—Robert R. Dexter
Assistant Treasurer—George R. Forman
Controller—Joseph J. Maitan

There being no further business, the meeting then adjourned.

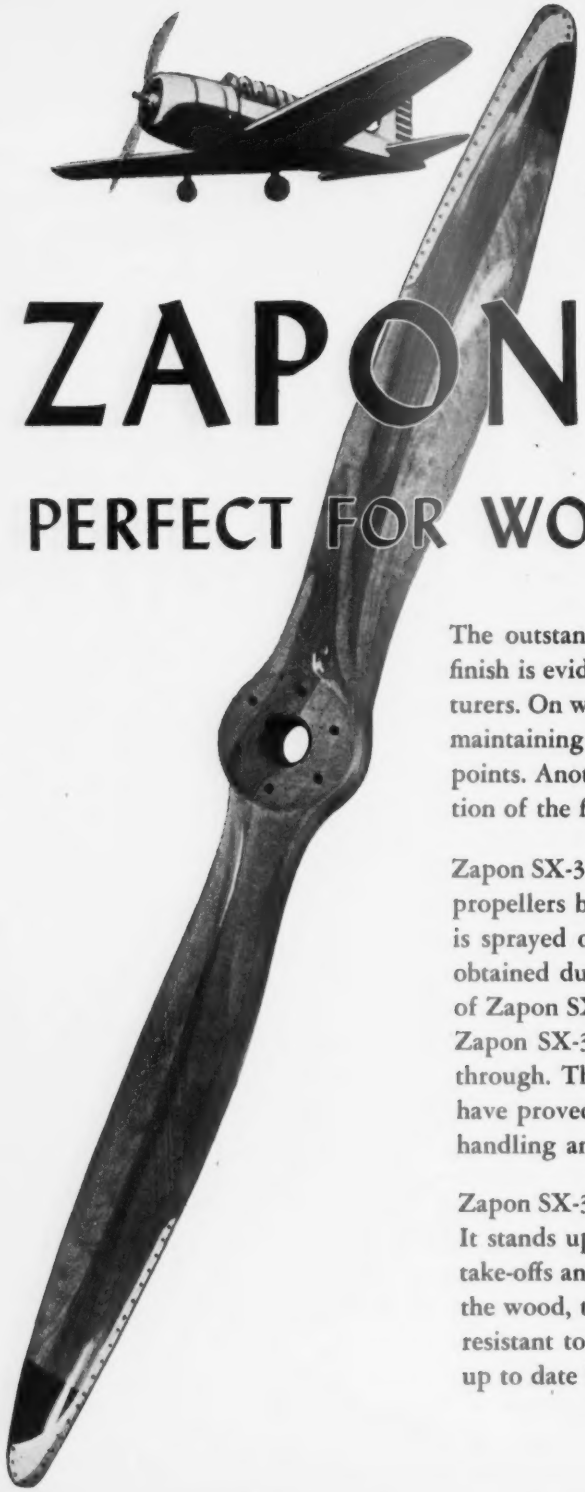
ROBERT R. DEXTER, *Secretary*

Important Notice

The April issue will contain a complete summary of the papers presented at the Technical Sessions of the Eleventh Annual Meeting

ZAPON SX-35

PERFECT FOR WOOD PROPELLERS



The outstanding success of Zapon SX-35 wood propeller finish is evidenced by its adoption by a number of manufacturers. On wooden propellers, excluding moisture as well as maintaining the moisture content of the wood are important points. Another highly important factor is speed of application of the finish.

Zapon SX-35 Wooden Propeller Finish is applied to wooden propellers by dipping the first three coats. The fourth coat is sprayed or brushed. Deep impregnation of the wood is obtained during the dip process. Due to the excellent flow of Zapon SX-35, a minimum amount of sanding is required. Zapon SX-35 Wooden Propeller Finish is used all the way through. The savings in time from using this base material have proved to be enormous, due to its fast drying, ease of handling and minimum of rejects.

Zapon SX-35 Wooden Propeller Finish is tough and flexible. It stands up better under the abuse a propeller receives on take-offs and landings. Being flexible enough, it moves with the wood, thus reducing cracking and checking. It is highly resistant to salt water. A very comprehensive booklet, kept up to date by new sheets, will be sent on request.

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